FAO Fisheries Synopsis No. 125, Volume 4, Part 1 FIR/S125 Vol. 4, Part 1

FAO SPECIES CATALOGUE

VOL. 4, PART 1 SHARKS OF THE WORLD

AN ANNOTATED AND ILLUSTRATED CATALOGUE OF SHARK SPECIES KNOWN TO DATE

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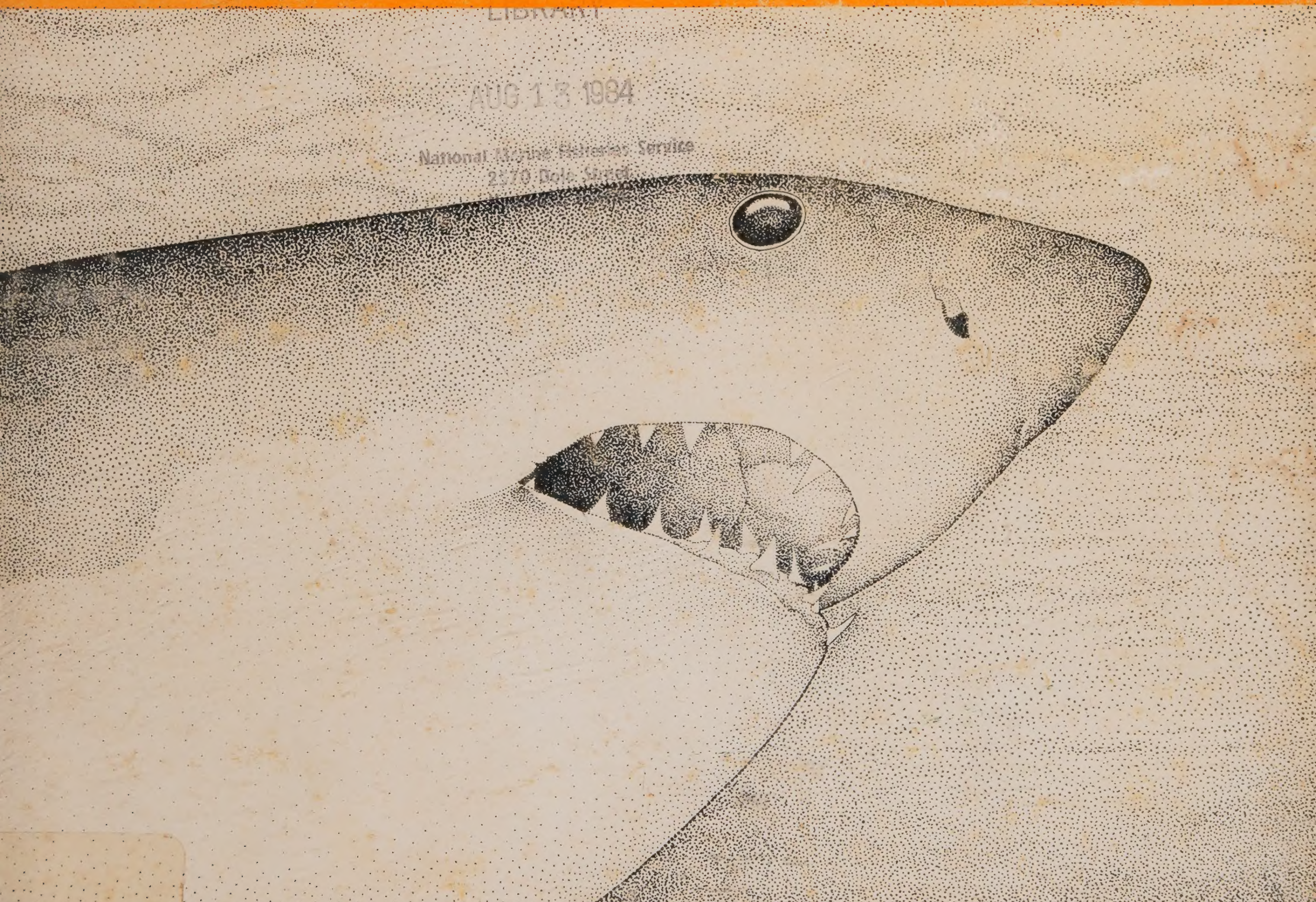

UNITED NATIONS DEVELOPMENT PROGRAMME
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FAO Fisheries Synopsis No. 125, Volume 4, Part 1 FIR/S125 Vol. 4, Part 1

FAO SPECIES CATALOGUE

VOL. 4 SHARKS OF THE WORLD

An Annotated and Illustrated Catalogue
of Shark Species Known to Date

Part 1 - Hexanchiformes to Lamniformes

prepared by

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- Prepared with support from the
United Nations Development Programme (UNDP)
and the American Elasmobranch Society

UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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PREPARATION OF THIS DOCUMENT

The present publication, prepared under the UNDP/FAO Project for the Survey and Identification of World-Marine Fish Resources (GLO/82/001), is the fourth worldwide species catalogue issued within the FAO Fisheries Synopses series.

Work on this catalogue was initiated by the author many years ago with the preparation of a simple list of shark species including only most elementary information such as scientific synonymies, geographical distributions, sizes, etc., preceded by an illustrated key to shark families. However, with the evolvement of a more ambitious format for the series, and parallel to the preparation of the volumes on scombrids and cephalopods, it became necessary to expand the original manuscript very substantially, a task which the author accomplished with his usual enthousiasm and thoroughness, in spite of the difficult conditions under which he had to work during the past years.

The work was facilitated by the author's involvement in several regional sets of FAO Species Identification Sheets for Fishery Purposes, e.g. the Western Central Atlantic, Eastern Central Atlantic and Western Indian Ocean, but the numerous gaps in information on species from the Indo-Pacific region could not have been filled without the author's recent extensive field work in that area, which was made possible thanks to the support of several institutions both within and outside the USA, coordinated by the American Elasmobranch Society.

In the final stages of the work, the author could count on the generous assistance of the J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa.

The indexes of scientific and common international FAO species names and of local species names were prepared in collaboration with FAO's Fishery Information, Data and Statistics Service.

Illustrations were adapted and redrawn by a wide variety of sources, especially from Okutani (1980).

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ABSTRACT

This is the fourth in the FAO series of worldwide annotated and illustrated catalogues of major groups of organisms that enter marine fisheries. The present volume includes 342 shark species belonging to 8 orders and 31 families. It provides a comprehensive and illustrated key to all orders and families of sharks, with a glossary of technical terms and measurements. Within each family are given individual accounts of species, which include drawings, scientific and vernacular names, information on habitat, biology and fisheries, and a distribution map; for most families there is also a key to genera. The work is fully indexed and there is ample reference to pertinent literature.

Distribution:

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1. INTRODUCTION

This catalogue includes all the described species of living sharks and their synonyms, including species of considerable and major importance to fisheries as well as those of potential, limited, and no current use. The catalogue fills a need for a comprehensive review of sharks of the world in a form accessible to fisheries workers as well as shark biologists, people who encounter sharks during the course of work in the sea, and the interested public. In recent years there has been a marked increase in our knowledge of shark systematics; and formerly difficult, poorly known groups of species have yielded to revisionary work. However, with a single exception there has been no comprehensive work in the past 70 years listing all shark species and their synonyms. Early post-Linnaean workers followed the tradition of Linnaeus' (1758) Systema Naturae in attempting to list, characterize and classify all known living sharks, but these workers were hampered by the Linnaean system, which allowed only a single genus, Squalus, for sharks. Some of the most important early comprehensive works are those of Bonnaterre (1788), Gmelin (1789), Bloch & Schneider (1801), and Cuvier (1817, 1829). By the beginning of the nineteenth century the Linnean Squalus was undergoing fragmentation, with the works of Rafinesque (1810), Blainville (1816) and Cuvier (1817) introducing the most innovations of this sort prior to Müller & Henle's revisions.

The advent of Müller & Henle's epocal Systematische Beschreibung der Plagiostomen (Müller & Henle, 1838-1841) essentially placed the classification of sharks (and their close relatives, the rays or batoids) on a modern footing. The Plagiostomen is a comprehensive review and synthesis of the work of previous writers and a bold step beyond the chaos of the previous century. It divided the elasmobranch fishes (plagiostomes, or sharks and rays) into many families and genera, most of which are recognized today. Of the sharks, some 13 of Müller & Henle's genera are in current use. The Plagiostomen probably is the most important single work that broadly covers the systematics of sharks and rays.

Subsequent comprehensive reviews, including those of Gray (1851), Dumeril (1865), Günther (1870), and Garman (1913) followed the conventions of Müller & Henle with considerable modifications. Gill (1862, 1873, 1896) reviewed the genera and classification of sharks while Engelhardt (1913) presented a concise checklist of living sharks along with a review of their zoogeography. Since the works of Garman and Engelhardt there have been partial and regional reviews of the sharks of considerable importance, including Fowler (1929, 1941), White (1937), Whitley (1940, revised as Whitley & Pollard, 1980), Bigelow & Schroeder (1948), Garrick & Schultz (1963), and more recently Springer (1966, 1979), Garrick (1967, 1967a, 1979), Compagno (1970, 1973a,c, 1979, 1982), Bass, D'Aubrey & Kistnasamy (1973, 1975c, 1976), Heemstra (1973), Nakaya (1975), Applegate et al. 1981, and Cadenat & Blache (1981). Steuben & Krefft (1978) is a semipopular work listing many species of sharks. Shiino (1976) and Lindberg, Heard & Rass (1980) have compiled lists of vernacular names of world fishes, which include many shark species.

The only modern comprehensive work listing the living sharks is contained in Fowler's partially published "Catalog of World Fishes" (sharks in Fowler, 1966-1969). This was published posthumously and is derived from Fowler's immense card catalogue on world fishes, which is apparently the most voluminous and comprehensive database of its kind in existence apart from the Pisces sections of the Zoological Record. Unfortunately, the shark section of the Catalog has many errors and shows the difficulties that arise when a compilation of species is made without the necessary revisionary work on many of the groups compiled. Fowler's catalogue of sharks is also outdated by revisionary work subsequent to its last entries (dated at 1958). Although an invaluable source work, the Catalog of World Fishes is difficult to use and is not recommended as a modern list of living sharks, especially to fisheries workers and others unfamiliar with shark systematics.

Of the approximately 350 species of living sharks that are currently known about 48% of them are to my knowledge of no use to fisheries; 25% are of limited use, 20% are of considerable importance, and 7% are major fisheries species. The 'useless' category is probably overlarge, due in part to my lack of fisheries information for many of the species. My experience in analyzing the results of a fisheries survey conducted by FAO prior to publishing the FAO Species Identification Sheets for Fishing Area 34 (see Compagno, 1981a for a summary of this survey as applied to sharks) convinced me that little-known species of sharks, especially deep-water species, are being taken in fisheries at least as a bycatch and at the minimum are being processed for fishmeal and oil. Formerly many deepwater sharks were primarily taken by scientific and exploratory fisheries expeditions and small-scale deepwater artisanal fisheries (such as off Madeira and Japan), but, with the advent of offshore international fleets with gigantic factory ships and trawlers as well as specialized deepwater shark fisheries aiming at processing shark liver oil for squalene, deepwater species are now being increasingly fished. The 48% 'useless' category includes many deepwater benthic members of the families Squalidae and Scyliorhinidae, at least some of which are quite likely being taken. It would be misleading and inappropriate to limit the present catalogue to the known 'useful' species, because most if not all species of sharks are of potential use for fisheries (if only for fishmeal and oil); and available fisheries data is sufficiently sketchy to make me strongly suspect that both the reported diversity of shark species being taken and the reported weights of world shark catches are lower than what is actually being caught. Quite often national, regional and world shark catch statistics are not segregated by species and are often lumped with catches of batoids. Often only major fisheries species such as piked dogfish (Squalus acanthias) or porbeagle (Lamna nasus) are listed separately in catch statistics (see FAO Yearbook of Fisheries Statistics, 1983).

I feel also that a comprehensive catalogue of world sharks can serve as an invaluable educational tool to the fisheries workers, to shark researches not specializing in taxonomy, to people encountering sharks in the field and uncertain of their danger or utility, and to the interested public at large as a guide to the taxonomic literature and to the numerous name changes and additions of species since the last comprehensive works on sharks were published. There are numerous taxonomic synonyms and dubious species names for sharks in the literature, averaging about 1.7 per valid species or about 5 for every 3 valid species described, with as many as 21 for a single species: the Carcharhinidae, with about 49 valid species, has over 150 synonyms, dubious names and nomina nuda for species. The present Catalogue lists all of the synonyms for shark species, genera and families, known to me; and for species lists common combinations of generic and specific names that have recently been used but are not considered valid.

1.1 Plan of the Catalogue

This Catalogue is based on original work on various groups of sharks as well as my interpretation of data in the literature. Some of the arrangements of families, genera and species used here disagree with those of previous workers, but in such cases the disagreements are discussed or reference is made to discussions in the literature. The systematic arrangement used here is based on my earlier works (Compagno, 1973c, 1977, 1979), which divides the sharks into eight major groups or orders. The relationships of the shark orders to each other and to the rays or batoids (Batoidea) is somewhat controversial at present, but in lieu of further work the linear arrangement of orders and families in Compagno (1973c) is largely adhered to in this Catalogue (Fig. 1).

Orders are the highest taxonomic groups dealt with here, and many of their synonyms are listed even though the present International Code of Zoological Nomenclature does not treat groups higher than the family-group level (superfamilies and below). The nomenclature for orders is that of Compagno (1973c), with older and newer equivalents listed from oldest to newest. The orders are suffixed with -iformes following common ichthyological practice at present. Families are suffixed with -idae, the universal ending for zoological families. Other levels between orders, families, genera and species are not covered here. Subgenera are discussed under their appropriate genera but species are not grouped under subgenera and given parenthetical subgeneric names such as Somniosus (Rhinoscymnus) rostratus, even where subgenera are considered valid, so as not to eliminate the utility of listing species alphabetically within genera. Subspecies are listed in the synonymies of their species but are not given separate cover.

Families, genera and species are provided with citations for their author, year of publication, reference and pagination (illustrations also included for species), while synonyms and combinations of genera and species recently used but at variance with the present text are cited with author and date only. The papers indicated in the citations of families, genera and species as well as those in which synonyms and combinations have appeared are not necessarily listed in the bibliography, but literature cited in other parts of the text is included there. The bibliography covers a wide selection of references used in writing the catalogue, but is not intended to be all-inclusive.

The information pertaining to each family, genus and species is arranged roughly in the form used in a previous catalogue in this series (Holthuis, 1980), but with considerable modifications. The family accounts include the valid modern form of the family name with author and year; the original citation of the family name with its author, year, reference and pagination; the FAO family vernacular name; family synonyms with name, author and year; a field marks and diagnostic features of members of the family; an account of the natural history of the family under Habitat, Distribution and Biology; a synopsis of the utility of members of the family to fisheries, under Interest to Fisheries; and a Remarks section.

Generic Accounts include the valid modern form of the genus name with author and year; the original citation of the genus or subgenus, with its author, year, reference and pagination, and, if a subgenus, the original genus name with author and year that the subgenus was placed in; the type species and means of designating it (for example, by original designation, monotypy, absolute tautonymy, or subsequent designation); generic synonyms, with their rank (genus, subgenus, or other genus-group ranking such as W.H. Leigh-Sharpe's 'pseudogenus'), author, year, and genus they were described in if subgenera or equivalents; sometimes field marks if genera are large; diagnostic features of the genus; a key to species; and a Remarks section.

Species Accounts include the valid modern name of the species, with author and date; the original citation of the species (or subspecies), with its author, year, reference pagination, and illustrations; a lateral view illustration, and often other useful parts of the shark in question; the English, French and Spanish FAO species vernacular names; the holotype, syntypes, lectotype or neotype of each species (paratypes are not listed in the present account), including the total length and sex of the specimen, its institutional deposition, and its catalogue number; the type locality (in the present case, the location and depth that the holotype, syntypes, lectotype or neotype were caught); species synonyms, including their names, authors and dates; a section listing other scientific names recently in use; field marks; diagnostic features (except in monotypic genera); geographical distribution, including a map; habitat and biology; size; interest to fisheries; sometimes local names; literature; and a remarks section.

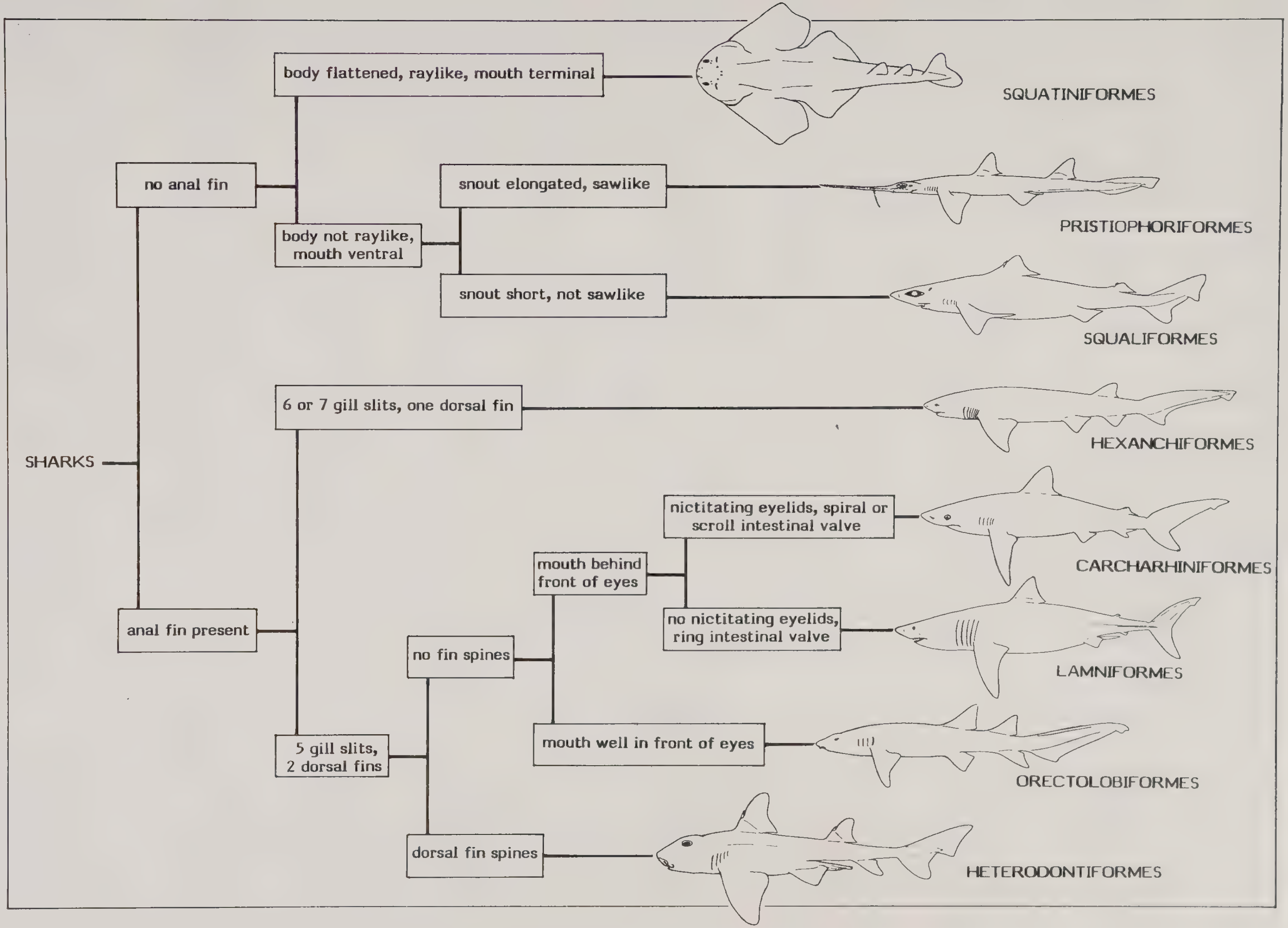
SHARKS
no anal fin
anal fin present
body flattened, raylike, mouth terminal
body not raylike, mouth ventral
snout elongated, sawlike
snout short, not sawlike
6 or 7 gill slits, one dorsal fin
5 gill slits, 2 dorsal fins
no fin spines
dorsal fin spines
mouth behind front of eyes
mouth well in front of eyes
nictitating eyelids, spiral or scroll intestinal valve
no nictitating eyelids, ring intestinal valve
SQUATINIFORMES
PRISTIOPHORIFORMES
SQUALIFORMES
HEXANCHIFORMES
CARCHARHINIFORMES
LAMNIFORMES
ORECTOLOBIFORMES
HETERODONTIFORMES

Fig. 1 Higher Classification of sharks (Orders)

Synonymy includes only true taxonomic synonyms of the valid family, genus and species given. For species, another category, Other Scientific Names Recently in Use, is provided for common misidentifications of a given species with another valid species (for example, Carcharhinus brachyurus was until recently often termed C. remotus, but the latter is a junior synonym of C. acronotus) as well as commonly used combinations that place a valid species in different genera (for example, Odontaspis taurus for Eugomphodus taurus).

FAO Family and Species Vernacular Names. English, French and Spanish names for each family and species, primarily for use within FAO, were selected by the following criteria: (a) each name applies to a single family or species worldwide; (b) the name conforms with FAO spelling nomenclature; (c) the name conforms to prior usage when possible. FAO names are not intended to replace local species names, but are necessary to overcome the confusion caused by the use of a single name for more than one species or several names for one species. The vernacular names used here conform with prior FAO usage and when possible and appropriate national and international checklists and reviews of species such as Whitley (1940), Shiino (1972, 1976), Hureau & Monod (1973), Smith (1975), Robins et al. (1980) and Lindberg, Heard & Rass (1980). The French names were selected jointly with Dr J.-C. Qu-ro, Institut Scientifique et Technique des Pêches Maritimes, Ministère de la Marine Marchande, La Rochelle, France. The names selected correspond to official French species nomenclature currently being established by the Direction des Pêches Maritimes. The selection of Spanish names presented considerable difficulties due to the lack of denominations for many species. Wherever possible, the "official" Spanish names adopted by F. Lozano in his book "Nomenclature ictiologica", Madrid 1963, were used.

The term 'shark' is virtually universally used as a catchall term in English for all members of the Class Chondrichthyes that are not batoids or chimaeras. The French 'requin' and Spanish 'tiburon' are comparable general terms. Several names not incorporating 'shark' or its French or Spanish equivalents are used for sharks and are not used for other fishes; these include the English 'dogfish' (a regional name for the bowfin, Amia calva, 'freshwater dogfish'), 'smoothhound', 'tope', 'porbeagle', and 'hammerhead' ('wobbegong' is adapted from an Australian Aboriginal term for sharks of the genera Eucrossorhinus and Orectolobus). French 'roussette', 'emissole', 'renard', 'milandre', 'marteau', and 'griset', and Spanish 'gato', 'cazon', 'tollo', 'pintarroja', and 'cornuda', are similar terms for certain kinds of sharks.

Usage of general vernacular names for different kinds of sharks varies from country to country. 'Catshark' is used for members of the Scyliorhinidae and sometimes related families (such as Proscylliidae) in the United States, but also for various orectoloboids in Australia. 'Dogfish' is variably used for members of the families Squalidae ('spiny dogfishes'), Scyliorhinidae (especially Scyliorhinus), and Triakidae ('smooth dogfishes', Mustelus spp.). 'Sand shark' may refer to Odontaspididae (especially Eugomphodus taurus, the 'sand tiger shark' of the eastern USA, called 'ragged-tooth shark' in South Africa and 'gray nurse shark' in Australia), to Triakidae (Mustelus spp.), or even to the batoid Rhinobatidae (guitarfishes). In the present catalogue 'catshark' is restricted to members of the Scyliorhinidae and Proscylliidae ('false catsharks' are members of the Pseudotriakidae), 'dogfish' to the Squalidae, and 'sand sharks' in the form of 'sand tiger shark' to the Odontaspididae. Orectoloboid 'catsharks' are termed 'carpetsharks', and 'sand sharks' and 'smooth dogfishes' of the triakid genus Mustelus are termed 'smoothhounds' (except for M. antarcticus, the Australian 'gummy shark').

Keys, Field Marks, and Diagnostic Features: These sections include identification data in different forms. Keys to orders, families, genera and species are standard dichotomous biological keys that are followed in steps of alternate choices to single out the taxa covered. Diagnostic Features are comprehensive lists of characters at the ordinal, familial, generic and species level, with the character choice generally limited to external characters because of space considerations and their primary purpose of identification rather than indication of relationships. The Diagnostic Features sections are hierarchical, with characters at the ordinal level not duplicated at the family, genus and species level. Monotypic orders with one family (such as Pristiophoriformes), monotypic families with one genus (Chlamydoselachidae) or monotypic genera with one species (Carcharodon) all have the Diagnostic Features section present only in the highest taxon covered. In a monotypic order, Diagnostic Features are omitted in the account of its single family; in a monotypic family, they are omitted from its single genus; and in a monotypic genus, they are omitted from its single species.

Field Marks include a few obvious characters of use in field identification, extracted from Diagnostic Features at various levels, but included in a separate section. Field Marks are listed at the ordinal, familial and species level, and occasionally the generic level in cases of large genera with many species. The arrangement of Field Mark characters is semihierarchical and may include characters from a higher level such as an order in lower level taxonomic accounts such as those of species, depending on their utility.

An example of the different application of Diagnostic Features and Field Marks is indicated with the sevengill shark, Heptranchias perlo. Starting with the Order Hexanchiformes, Diagnostic Features applicable to it are given at decreasing hierachical levels through the Family Hexanchidae and Genus Heptranchias (a monotypic genus). However, the species account of H. perlo also has a short Field Marks section, "A narrow-headed, big-eyed, small seven-gilled shark with one dorsal fin", that can suffice to identify it without additional information, although this is available in the Diagnostic Features sections as needed. In some large families like the Carcharhinidae the Field Marks for an easily recognized species like Carcharhinus longimanus may not repeat familial and ordinal characters but merely indicates its family and unique characters.

Geographical Distribution and Maps . Sharks are primarily marine organisms, but a number of species readily enter brackish to almost freshwater estuaries, lagoons and bays; a few species of the family Carcharhinidae occur far up rivers and in freshwater lakes with connections to the sea. Distributions for nearly all species are given by listing the countries off the coasts of which the sharks occur. In the case of two species of carcharhinids (*Carcharhinus leucas* and *Glyphis gangeticus*) that are known from verifiable records from entirely freshwater parts of rivers and freshwater lakes, the names of major river systems and lakes where they occur are noted. There are various freshwater records of other members of the family Carcharhinidae and even some other families (including the zebra shark family, Stegostomatidae) but many of these records may be from almost freshwater lower reaches of rivers and estuaries and may indicate the species involved is euryhaline but incapable of existing in fresh water far from the sea as can *C. leucas*, apparently *G. gangeticus*, and among batoids some sawfish (Pristidae), potamotrygonid stingrays, and some dasyatid stingrays. Some of these carcharhinid freshwater records may be based on *C. leucas* or *Glyphis* species rather than the species indicated (such as *C. melanopterus* or *C. hemiodon*).

In compiling distributional data and preparing maps, it was noted that the distributions of many wide-ranging coastal species are very spotty as known at present, especially with species occurring in the Indian Ocean and western Pacific. In many cases gaps in distribution may not indicate absence of a given species but absence of knowledge. Continental slope shark faunas are poorly known for much of the world, and a number of deepwater species may have wider ranges than are currently known. The locality data in the literature and on specimen labels is often very general and imprecise; and even with detailed oceanographic data trawl hauls may be of such long duration that locations are approximate. Hence distributional data and maps presented here is to be considered as rough approximations of distribution. Much effort was made to screen out misinformation on shark distribution, based on misidentifications of species, to the cost of presenting distributional lists and maps that are spotty if more accurate. An extreme example is discussed in detail under *Glyphis gangeticus* (Carcharhinidae).

Habitat and Biology . This section covers information on natural history. The known depth range of the species (in meters), position in the water column, type of substrate occupied, and preferences relative to coasts are noted when available. In most species data on salinity, oxygen content, and specific temperature of the water in which they occur is not available or not in an easily usable form and has not been compiled here. Also included are data on population structure and dynamics, reproduction, behaviour, age and growth, feeding and danger to people. In compiling the data it was noted that very few species are biologically well known, and even in the piked dogfish (*Squalus acanthias*), the best-known of living sharks, there are areas of its biology that are very poorly known (such as its ethology). There is a bias in available natural history data towards reproductive biology, feeding, shark attack and fisheries-related subjects, and correspondingly little on ecology and behaviour.

Size . All size data is given as total lengths; this is the measurement most often used as an independent variable and standard measurement in the shark literature, although particularly in fisheries papers precaudal lengths, fork lengths, and other measurements have been used from choice or necessity. Unfortunately shark workers have not agreed on a standard method of measuring total length, so total lengths from different sources in the literature may not be strictly comparable. I prefer and advocate as a standard method a direct measurement, in which the shark is held belly down with its dorsal caudal lobe depressed into line with its body axis and total length measured as a point to point distance (not over the curve of the body) from the snout tip to the tip of the dorsal caudal lobe (see also Compagno, 1979, 1981a). This method lends itself readily to quick use of a fishboard with a perpendicular front bar or plate to index the sharks's snout against, a metre or two metre ruler of folding rule slipped under the shark, or even a steel or cloth tape, and avoids the trouble of computation and possible errors and loss of data.

A comparable computational method adding the lengths from snout tip to caudal origin and of the dorsal caudal margin is advocated by Sadowsky (1968). Bigelow & Schroeder (1948) and V. Springer (1964) measured total length from the snout tip along the body axis to a vertical projection from the tip of the dorsal caudal lobe with the caudal fin in a 'natural position'. Bass (1973) advocated a computational method which adds the length from snout tip to caudal origin to a number computed by multiplying the length of the dorsal caudal margin by a constant (1.0 or less; 0.97 and 0.80 were the numbers used) that corrects for the 'natural' angle of the caudal axis to the body axis in different species. The method advocated here dispenses with all computation for determining total length and avoids arbitrary constants to correct for supposed 'natural positions' of the caudal axis as well as the difficulties in obtaining accurate vertical projections from arbitrary 'natural positions'. Also, with the present method a comparable measurement can be obtained for all sharks, rays and chimaeras; in contrast 'natural position' methods arbitrarily generate incompatable total lengths for different sharks.

Total length data presented includes maximum size, size at maturity (in some cases, a size range at maturity, when abundant data was available) and maximum size for both sexes (as sexual dimorphism in size is nearly universal among sharks, with females usually attaining larger sizes than males), and size at birth or hatching. Sometimes size when either or both sexes mature is not known, in which cases reported minimum and maximum sizes of adult individuals are given. In some cases maximum size exceeds that recorded for either sex, in which case the sex of the outsized individual or individuals representing the maximum size measurements was not recorded. In some poorly known species only immature individuals are known, in which case the hypothetical maximum size is almost certainly larger than the known immature maximum (no cases of adult sharks that are considerably smaller than large immatures are known, unlike some other vertebrates)

In a small number of species length-weight equations are presented, usually of the form WT = a + TL exp b, where Wt is weight, a and exp b are constants, and TL is total length.

Interest to Fisheries . As noted above, fisheries data for sharks is often sketchy and combined for a number of species. In this section data on localities of fisheries, gear used, and uses of the particular species are noted when available. Catch statistics on single species were available for only a few sharks but are noted when available.

Local Names : Local vernacular names are usually not listed in the present version of this catalogue because these names are spottily covered in the literature; no worldwide survey of current usage exists, although Fowler (1966-1969), Shiino (1976) and Lindberg, Heard & Rass (1980) have compiled vernacular names from the literature for a number of species. Due to time constraints a survey or regional vernacular names could not be attempted and compiled here, but a few alternate regional names (mostly in English) are listed when these have sufficiently wide and consistant usage so that their inclusion is very helpful. Examples include school shark (Australia), tiburon vitaminico or vitamin shark (Uruguay and Argentina) and soupfin shark (Pacific USA and Canada) for the tope shark (Galeorhinus galeus); and ragged-tooth shark (South Africa) and gray nurse shark (Australia) for the sand tiger shark (Eugomphodus taurus).

Literature : References cited here includes specific works with important information as well as comprehensive accounts on species, and is not intended as an extensive bibliography.

Remarks . Important information, especially on systematics and nomenclature, not represented elsewhere are given here.

Acknowledgements

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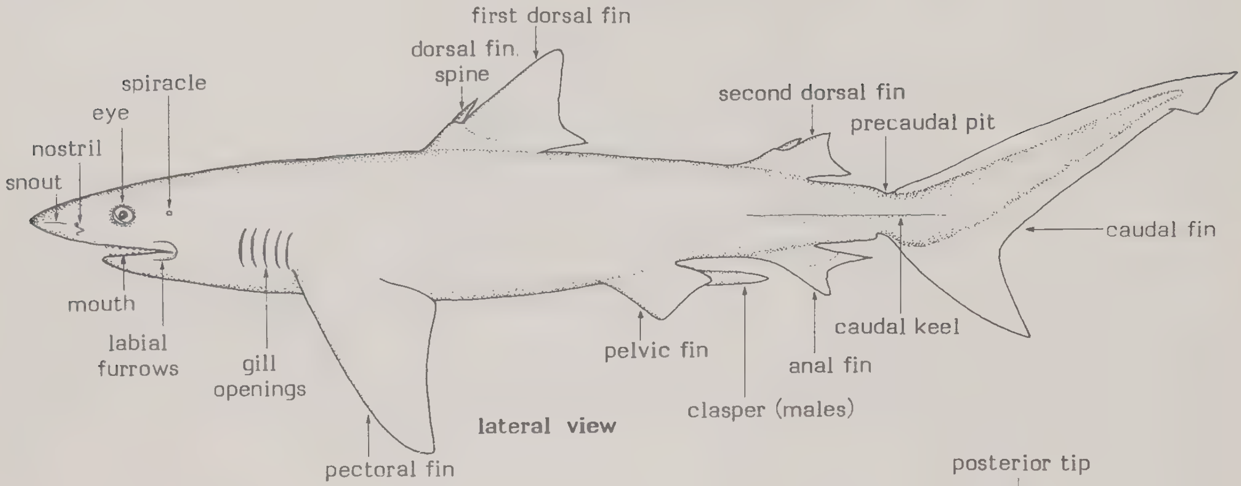
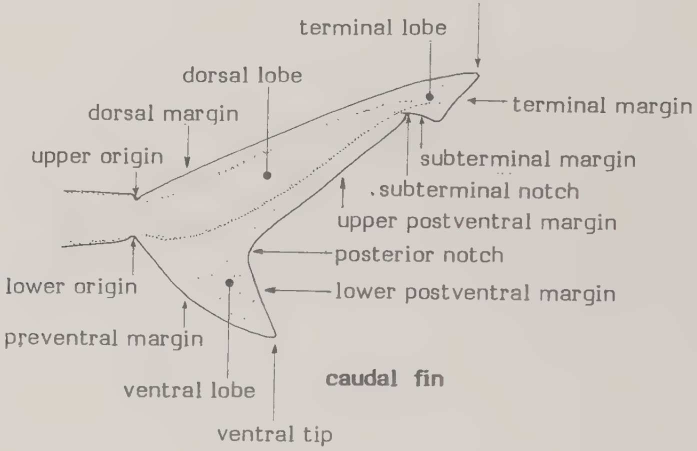
1.2 Technical Terms and Measurements

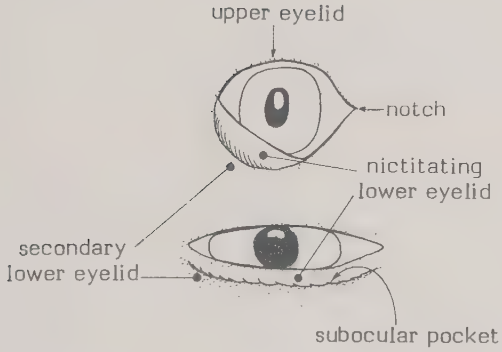
1.2.1 Picture Guide to Terminology of Sharks


first dorsal fin
dorsal fin spine
spiracle
eye
nostril
snout
second dorsal fin
precaudal pit
caudal fin
mouth
labial furrows
gill openings
pectoral fin
pelvic fin
clasper (males)
anal fin
caudal keel

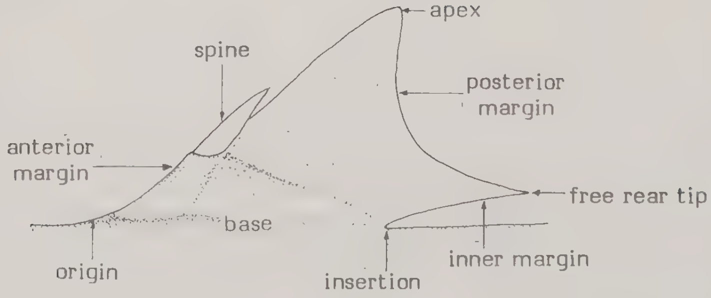
lateral view


posterior tip
terminal lobe
dorsal lobe
dorsal margin
upper origin
terminal margin
subterminal margin
subterminal notch
upper postventral margin
posterior notch
lower origin
lower postventral margin
preventral margin
ventral lobe
ventral tip

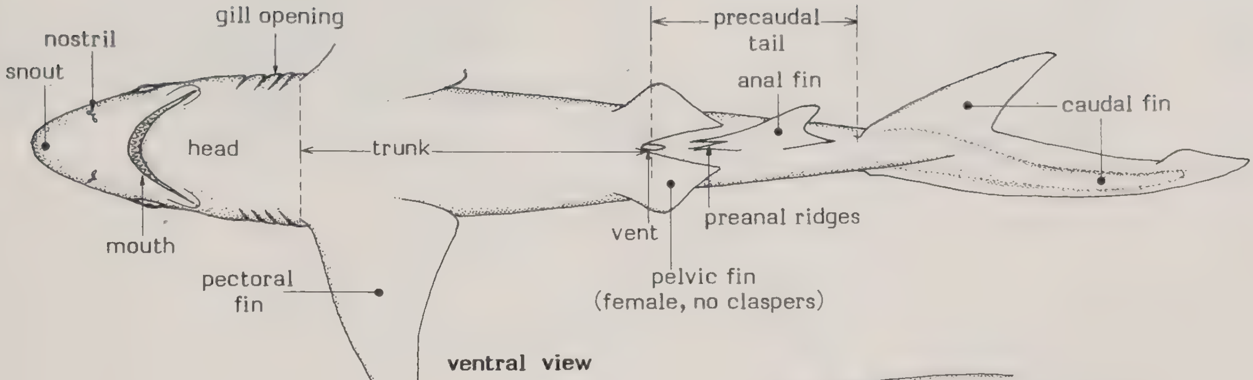
caudal fin


upper eyelid
notch
nictitating lower eyelid
secondary lower eyelid
subocular pocket

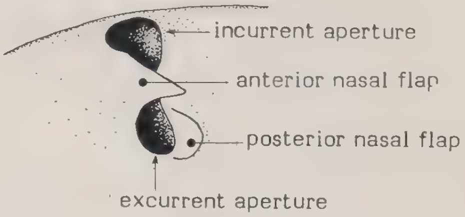
eyes


apex
spine
posterior margin
anterior margin
free rear tip
base
origin
insertion
inner margin

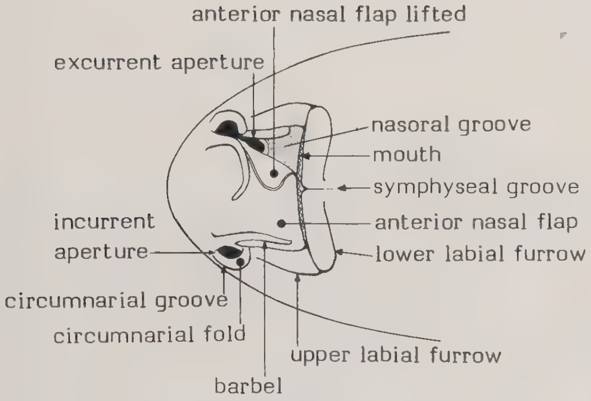
dorsal fin


gill opening
nostril
snout
head
trunk
mouth
pectoral fin
precaudal tail
anal fin
caudal fin
vent
preanal ridges
pelvic fin (female, no claspers)

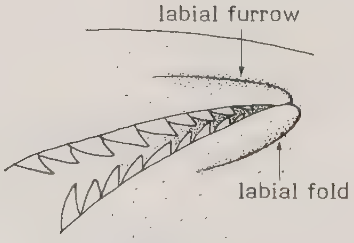
ventral view


incurrent aperture
anterior nasal flap
posterior nasal flap
excurrent aperture

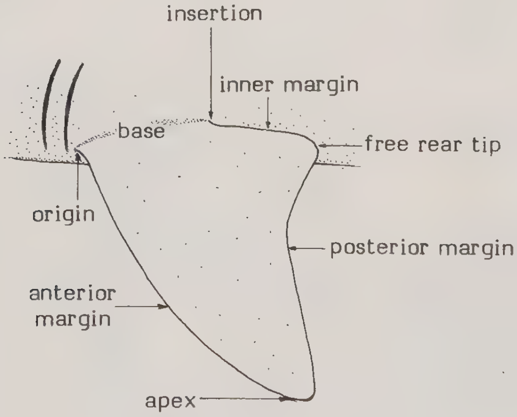
nostril


anterior nasal flap lifted
excurrent aperture
nasoral groove
mouth
symphyseal groove
incurrent aperture
anterior nasal flap
lower labial furrow
circumnarial groove
circumnarial fold
upper labial furrow
barbel

diagrammatic orectoloboid head


labial furrow
labial fold

mouth corner

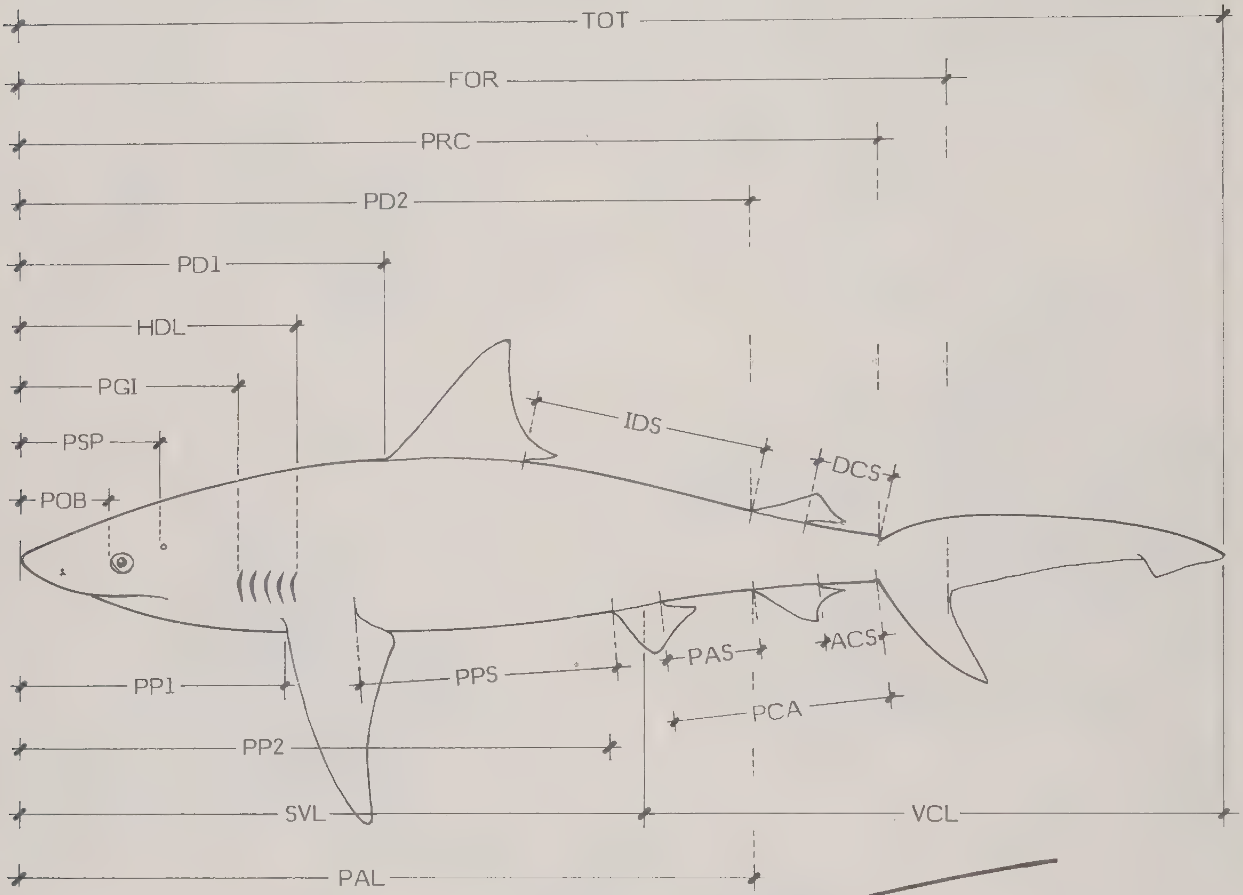

insertion
inner margin
base
free rear tip
origin
posterior margin
anterior margin
apex

pectoral fin

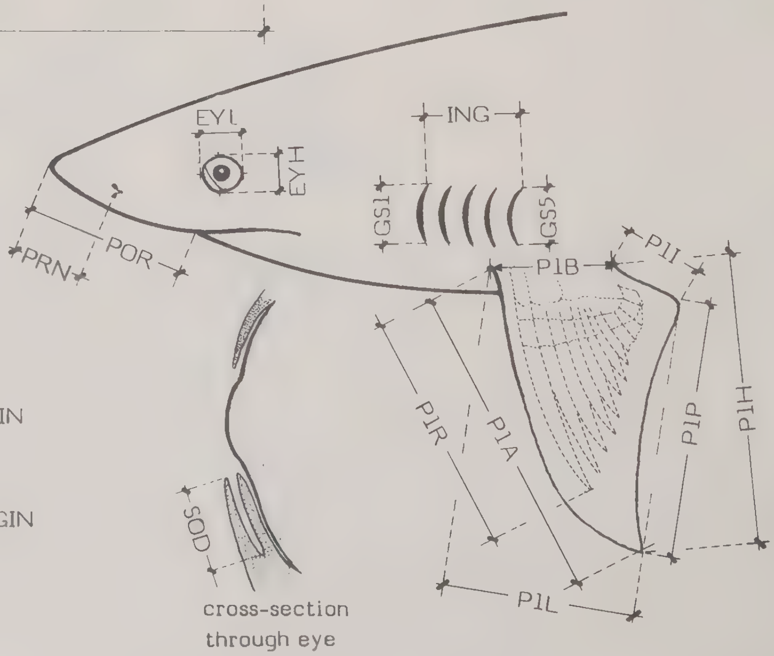
1.2.2 Measurements Used for Sharks

TOT = TOTAL LENGTH
FOR = FORK LENGTH
PRC = PRECAUDAL LENGTH
PD2 = PRE-SECOND DORSAL LENGTH
PD1 = PRE-FIRST DORSAL LENGTH
HDL = HEAD LENGTH
PG1 = PREBRANCHIAL LENGTH
PSP = PRESPIRACULAR LENGTH
POB = PREORBITAL LENGTH
PP1 = PREPECTORAL LENGTH

PP2 = PREPELVIC LENGTH
SVL = SNOUT-VENT LENGTH
PAL = PREANAL LENGTH
IDS = INTERDORSAL SPACE
DCS = DORSAL-CAUDAL SPACE
PPS = PECTORAL-PELVIC SPACE
PAS = PELVIC-ANAL SPACE
ACS = ANAL-CAUDAL SPACE
PCA = PELVIC-CAUDAL SPACE
VCL = VENT-CAUDAL LENGTH

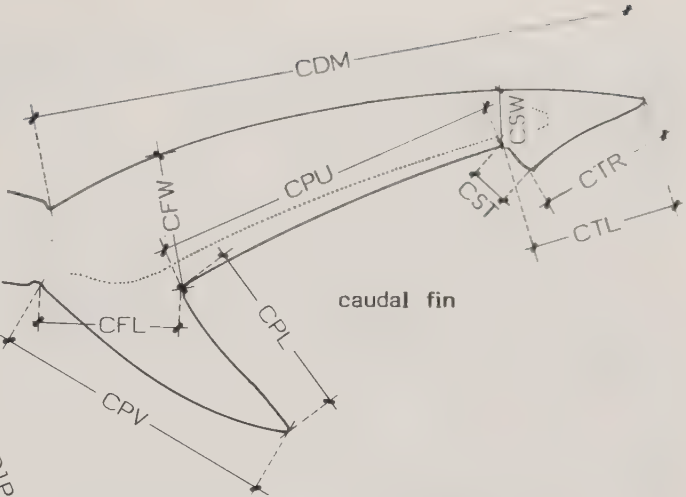

TOT
FOR
PRC
PD2
PD1
HDL
PGI
PSP
POB
IDS
DCS
PPS
PAS
ACS
PCA
PP1
PP2
SVL
VCL
PAL

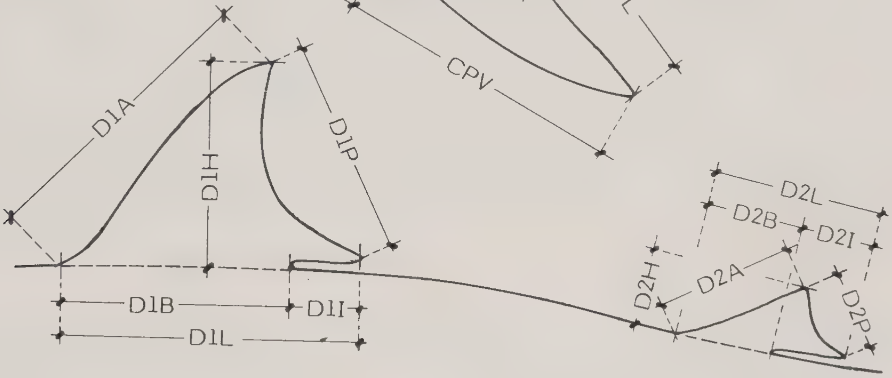
PRN = PRENARIAL LENGTH
POR = PREORAL LENGTH
EYL = EYE LENGTH
EYH = EYE HEIGHT
ING = INTERGILL LENGTH
GS1 = FIRST GILL SLIT HEIGHT
GS2 = SECOND GILL SLIT HEIGHT
GS3 = THIRD GIL SLIT HEIGHT
GS4 = FOURTH GILL SLIT HEIGHT
GS5 = FIFTH GILL SLIT HEIGHT
GS6 = SIXTH GILL SLIT HEIGHT
GS7 = SEVENTH GILL SLIT HEIGHT
P1A = PECTORAL ANTERIOR MARGIN
P1R = PECTORAL RADIAL LENGTH
P1B = PECTORAL BASE
P1I = PECTORAL INNER MARGIN
P1P = PECTORAL POSTERIOR MARGIN
P1H = PECTORAL HEIGHT
SOD = SUBOCULAR POCKET DEPTH

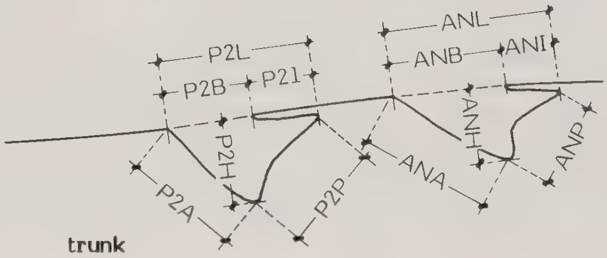

EYL
EYH
ING
GS1
GS5
PRN
POR
P1B
P1I
P1R
P1A
P1P
P1H
SOD
P1L

cross-section
through eye

CDM = DORSAL CAUDAL MARGIN
CPV = PREVENTRAL CAUDAL MARGIN
CPU = UPPER POSTVENTRAL CAUDAL MARGIN
CPL = LOWER POSTVENTRAL CAUDAL MARGIN
CFW = CAUDAL FORK WIDTH
CFL = CAUDAL FORK LENGTH
CST = SUBTERMINAL CAUDAL MARGIN
CSW = SUBTERMINAL CAUDAL MARGIN
CTR = TERMINAL CAUDAL MARGIN
CTL = TERMINAL CAUDAL LOBE


CDM
CSW
CPU
CST
CTR
CTL
CFW
caudal fin
CFL
CPL
CPV


D1A
D1H
D1P
D1B
D1I
D1L
D2L
D2B
D2I
D2H
D2A
D2P

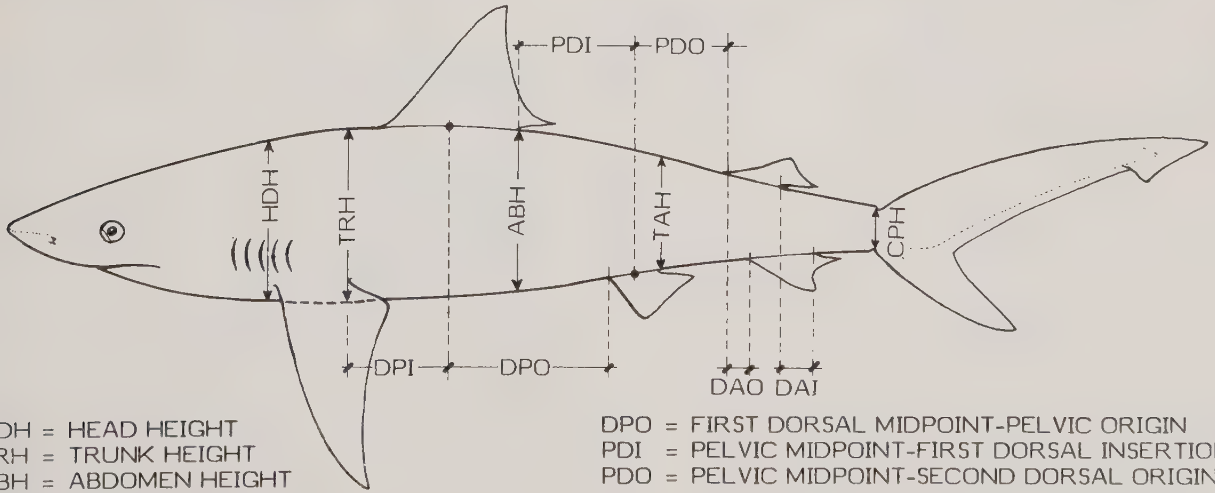

ANL
P2L
ANB
ANI
P2B
P21
ANH
P2H
ANP
ANA
P2A
P2P
trunk

D1L = FIRST DORSAL LENGTH
D1A = FIRST DORSAL ANTERIOR MARGIN
D1B = FIRST DORSAL BASE
D1H = FIRST DORSAL HEIGHT
D1I = FIRST DORSAL INNER MARGIN
D1P = FIRST DORSAL POSTERIOR MARGIN

D2L = SECOND DORSAL LENGTH
D2A = SECOND DORSAL ANTERIOR MARGIN
D2B = SECOND DORSAL BASE
D2H = SECOND DORSAL HEIGHT
D2I = SECOND DORSAL INNER MARGIN
D2P = SECOND DORSAL POSTERIOR MARGIN

P2L = PELVIC LENGTH
P2A = PELVIC ANTERIOR MARGIN
P2B = PELVIC BASE
P2H = PELVIC HEIGHT
P2I = PELVIC INNER MARGIN LENGTH
P2P = PELVIC POSTERIOR MARGIN LENGTH

ANL = ANAL LENGTH
ANA = ANAL ANTERIOR MARGIN
ANB = ANAL BASE
ANH = ANAL HEIGHT
ANI = ANAL INNER MARGIN
ANP = ANAL POSTERIOR MARGIN

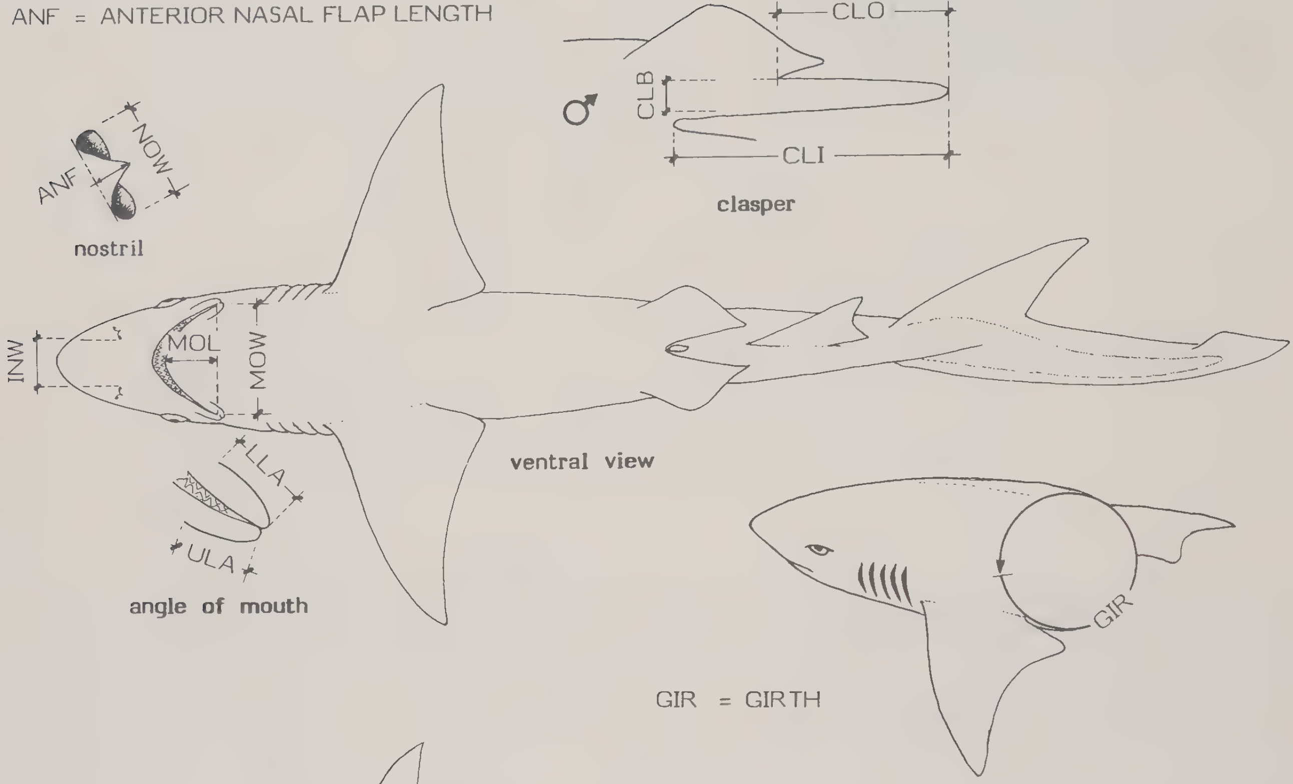

PDI
PDO
HDH
TRH
ABH
TAH
CPH
DPI
DPO
DAO
DAI

HDH = HEAD HEIGHT
TRH = TRUNK HEIGHT
ABH = ABDOMEN HEIGHT
TAH = TAIL HEIGHT
CPH = CAUDAL PEDUNCLE HEIGHT

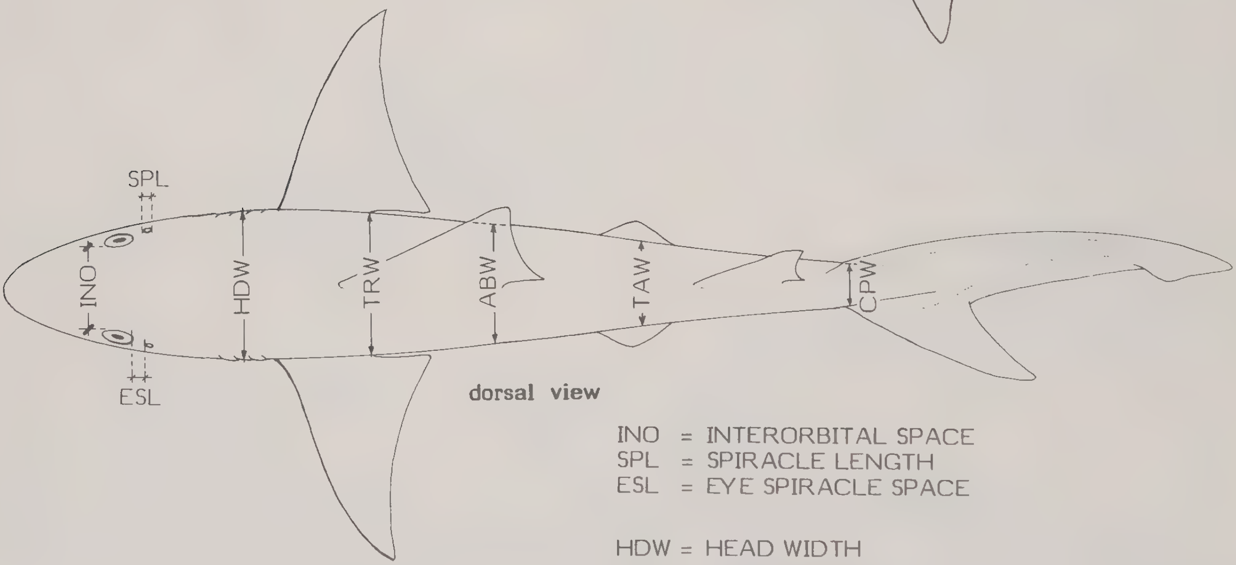
DPO = FIRST DORSAL MIDPOINT-PELVIC ORIGIN
PDI = PELVIC MIDPOINT-FIRST DORSAL INSERTION
PDO = PELVIC MIDPOINT-SECOND DORSAL ORIGIN
DAO = SECOND DORSAL ORIGIN-ANAL ORIGIN
DAI = SECOND DORSAL INSERTION-ANAL INSERTION

MOL = MOUTH LENGTH
MOW = MOUTH WIDTH
ULA = UPPER LABIAL FURROW LENGTH
LLA = LOWER LABIAL FURROW LENGTH
NOW = NOSTRIL WIDTH
INW = INTERNARIAL SPACE
ANF = ANTERIOR NASAL FLAP LENGTH

CLO = CLASPER OUTER LENGTH
CLI = CLASPER INNER LENGTH
CLB = CLASPER BASE WIDTH


CLO
♂
CLB
CLI
clasper
NOW
ANF
nostril
INW
MOL
MOW
ventral view
LLA
ULA
angle of mouth
GIR

GIR = GIRTH


SPL
INO
HDW
TRW
ABW
TAW
CPW
ESL
dorsal view

INO = INTERORBITAL SPACE
SPL = SPIRACLE LENGTH
ESL = EYE SPIRACLE SPACE

HDW = HEAD WIDTH
TRW = TRUNK WIDTH
ABW = ABDOMEN WIDTH
TAW = TAIL WIDTH
CPW = CAUDAL PEDUNCLE WIDTH

2. ORDER HEXANCHIFORMES - FRILLED AND COW SHARKS

Order Hexanchiformes Compagno, 1973c, *J.Linn.Soc.(Zool.), Lond.*, 53, suppl. 1:37 p.

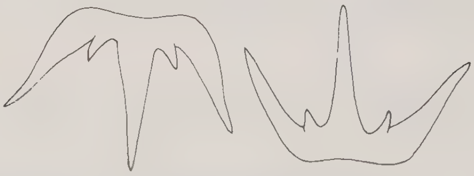
Synonymy : Superorder Carcharhini, Order Hexanchida, Suborder Hexanchoidei: Glikman, 1967 (in part). Superorder Chlamydoselachii, Order Chlamydoselachida: Glikman, 1967 (in part). Order Chlamydoselachiformes: Rass & Lindberg, 1971 (in part), Applegate, 1974 (in part). Suborder Chlamydoselachoidea: Bigelow & Schroeder, 1948 (in part). Order Diplospondyli: Jordan & Evermann, 1896, Fowler, 1941, Smith, 1949. Suborder Galei: Gill, 1872 (in part). Order Hexanchea: White, 1936, 1937, Whitley, 1940 (in part). Order Hexanchida: Fowler, 1967a. Suborder Hexanchida: Matsubara, 1955. Order Hexanchiformes: Berg, 1940, Berg & Svedovidov, 1955, Arambourg & Bertin, 1958, Patterson, 1967, Lindberg, 1971, Rass & Lindberg, 1971 (in part), Applegate, 1974 (in part), Nelson, 1976, Chu & Wen, 1979. Suborder Hexanchiformes: Budker & Whitehead, 1971. Order Hexanchoidea: Schultz & Stern, 1948. Suborder Hexanchoidea: Romer, 1966. "Group" Hexanchoidei: Garman, 1913. Order Notidani: Jordan, 1923 (in part). Suborder Notidani: Goodrich, 1909. Suborder Notidaniformes: Lozano y Rey, 1928, Bertin, 1939. Suborder Notidanoidea: Romer, 1945, Bigelow & Schroeder, 1948 (in part), Norman, 1966. "Division" Notidanoidei: Regan, 1906. Suborder Notidanoidei: Engelhardt, 1913. Order Opistharthri: Gill, 1893. (? Suborder) Palaeonotidani: Hasse, 1879. Order Pternodonta: Gill, 1884 (in part). Order Selachii: Blot, 1969 (in part). Order Selachophichthyoidi: Garman, 1884 (in part), Jordan, 1923 (in part), Whitley, 1940 (in part).

Field Marks : 6 or 7 pairs of gill slits, one dorsal fin, anal fin.

Diagnostic Features : Trunk cylindrical or somewhat compressed, not flattened and raylike. Head conical to slightly depressed, not expanded laterally; 6 or 7 pairs of gill slits present on sides of head, with the posteriormost in front of pectoral fin origins; spiracles present and very small, well behind and above level of eyes; nostrils without barbels, nasoral grooves or circumnarial grooves, separate from mouth, anterior nasal flaps short and not reaching mouth; eyes on sides of head, without nictitating lower eyelids; snout very short to moderately long, truncated to conical, not greatly elongated or flattened, and without lateral teeth or rostral barbels; mouth large, arched and elongated, extending well behind eyes; labial furrows reduced or absent, on lower jaw when present; teeth weakly to strongly differentiated along the jaws, without enlarged anterior or posterior teeth and without a gap or small intermediate teeth between anterior and lateral teeth in the upper jaw. A single spineless dorsal fin present, with origin over or behind pelvic fin insertions; pectoral fins small to moderately large, not expanded and raylike, without triangular anterior lobes that cover the gill slits; pelvic fins small to moderately large, with vent continuous with their inner margins; anal fin present; caudal fin with a long dorsal lobe and the ventral lobe short to absent; vertebral axis elevated into the dorsal caudal lobe. Intestinal valve of spiral or ring type.

Key to Families :

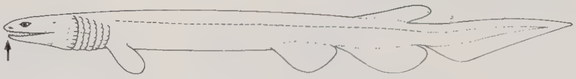
1a. Body elongated and eel-like; mouth nearly terminal on head; 3-cusped teeth in upper and lower jaws (Figs 1,2) - Frilled sharks ....**Family Chlamydoselachidae**
(one genus, *Chlamydoselachus*)



upper and lower tooth
Chlamydoselachus

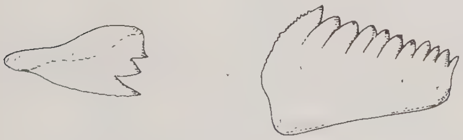
Fig. 1

1b. Body stouter, not eel-like; mouth subterminal on head; high, long-cusped teeth in upper jaw, larger, comblike teeth in lower jaw (Figs 3,4) - Cow sharks .... **Family Hexanchidae**
(see key to genera)



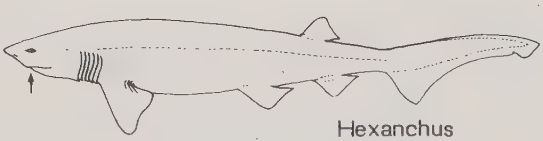
Chlamydoselachus

Fig. 2



upper and lower tooth
Hexanchus

Fig. 3



Hexanchus

Fig. 4

2.1 FAMILY CHLAMYDOSELACHIDAE Garman, 1884

CHLAM

Chlamydoselachidae Garman, 1884, Bull.Essex Inst., 16:8.

Synonymy : None.

FAO Names : En - Frilled sharks; Fr - Requins à collerette; Sp - Tiburones anguila.

Genera : A single genus, Chlamydoselachus Garman, 1884.

Diagnostic Features : Body slender and eel-like, with prominent keels on abdomen. Head with 6 pairs of gill slits, the lower ends of the first gill slits connected to each other across throat; snout extremely short, truncated; mouth terminal on head, very long; teeth alike in upper and lower jaws, with three strong cusps and a pair of intermediate cusplets, not saw or bladelike, posterior teeth not minute and granular. Anal fin large, larger than dorsal fin; caudal fin without a subterminal notch.

Chlamydoselachus Garman, 1884

CHLAM Chlam

Genus : Chlamydoselachus Garman, 1884, Bull.Essex Inst., 16:8.

Type Species : Chlamydoselachus anguineus Garman, 1884, by monotypy.

Synonymy : Genus Chlamydoselache Günther, 1887 (emendation).

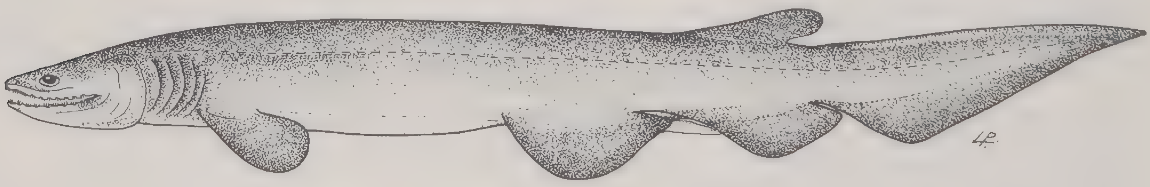
Chlamydoselachus anguineus Garman, 1884

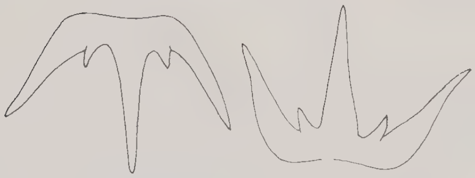
CHLAM Chlam 1

Chlamydoselachus anguineus Garman, 1884, Bull.Essex Inst., 16:3, fig. Holotype: Museum of Comparative Zoology, Harvard University (MCZ). Type Locality: Japan, probably southeastern Honshu.

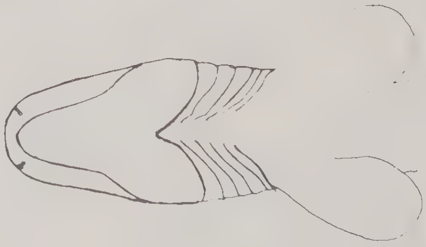
Synonymy : None.

FAO Names : En - Frilled shark; Fr - Requin lézard; Sp - Tiburón anguila.





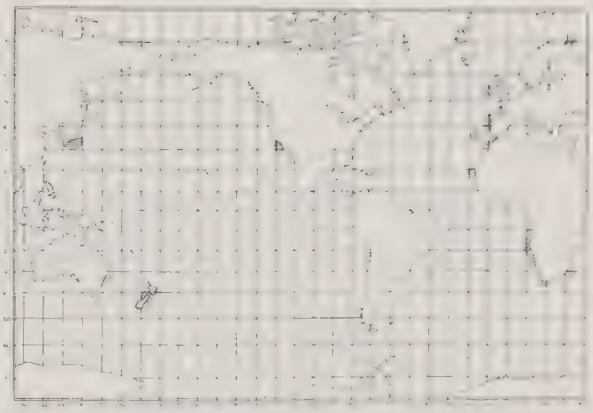
upper and lower tooth



underside of head

Field Marks : Eel-like shark with 6 gill slits, terminal mouth with tricuspid teeth in both jaws, and one dorsal fin.

Diagnostic Features : See family.



Geographical Distribution : Wide-ranging but spottily distributed. Eastern Atlantic: From northern Norway, the Atlantic Slope off northern Scotland and western Ireland, France, Spain, Portugal, Morocco, Mauritania, Madeira, Angola, northern Namibia, and possibly the eastern Cape of Good Hope, South Africa. Western Indian Ocean: Off South Africa. Western Pacific: Off Japan (southeastern Honshu), Australia (New South Wales), and New Zealand. Eastern Pacific. Southern California, USA, northern Chile.

Habitat and Biology : Benthic on the outer continental and insular shelves and upper slopes, at depths usually between 120 and 1280 m, but occasionally taken at the surface.

A rare, little known deepwater shark. Ovoviviparous, number of young 8 to 12. Apparently reproduces all year in deep water off Japan; gestation period probably very long, one to two years. Feeding habits unknown, but the needle-sharp, slender-cusped teeth of this shark suggest feeding on deepwater cephalopods and bottom fishes. Not dangerous, but teeth can lacerate the hands of the unwary scientist examining its mouth.

Size : Maximum 196 cm, size at birth about 39 cm; size at maturity about 97 cm for males and 135 cm for females.

Interest to Fisheries : Of little importance, taken incidentally in bottom trawls catches, formerly caught with deepset longlines off Japan. Utilized for fishmeal and for human consumption.

Literature : Gudger & Smith (1933); Gudger (1940); Bass, d'Aubrey & Kistnasamy (1975c); Cadenat & Blache (1981); Compagno (1981).

2.2 FAMILY HEXANCHIDAE Gray, 1851

HEX

Tribe Hexanchina Gray, 1851, List Fish British Mus., Part I, Chondropterygii, Brit.Mus.(Nat.Hist.):67 (Family Squalidae).

Synonymy : Subfamily Notidanini Bonaparte, 1838 (Family Squalidae); Family Hexeptranchidae Garman, 1913; Family Heptranchidae Barnard, 1925.

FAO Names : En - Cow sharks, Sevengill sharks, Sixgill sharks; Fr - Requins à six et sept fentes branchiales, Requins grisés, Requins perlon, Requins vaches; Sp - Cañabotas.

Field Marks : Cylindrical sharks with 6 or 7 gill slits, subterminal mouth with large, bladelike, comb-shaped teeth in lower jaw, and one dorsal fin.

Diagnostic Features : Body cylindrical and moderately slender to stout, without keels on abdomen. Head with 6 or 7 pairs of gill slits, the lower ends of the first gill slits not connected to each other across throat; snout short to moderately long, conical and slightly pointed to broadly rounded; mouth subterminal on snout, moderately long; teeth well-differentiated in upper and lower jaws, upper anterolaterals small, narrow, with a main cusp and often smaller cusplets, lowers very broad, compressed and sawlike, with a series of large cusplets and a short to elongated cusp; posterior teeth small and granular at corners of dental bands. Anal fin small, smaller than dorsal fin; caudal fin with a strong subterminal notch.

Habitat, Distribution and Biology : Cow sharks have a worldwide distribution in boreal and cold temperate to tropical seas. Most species are deepwater inhabitants of the outer continental shelves, upper continental slopes, insular shelves and slopes, and submarine canyons down to at least 1875 m depth, near the bottom or well above it; but also occurring in shallow bays, close inshore, and near the surface. Behaviour of these sharks is poorly known: they are sluggish to active often strong-swimming sharks that occur near the bottom. They range in size from small to very large, with various species between 1.4 to 4.8 m maximum total length at maturity.

They feed on relatively large marine organisms, including other sharks, rays, a wide variety of bony fishes, crustaceans, and carrion (including mammalian meat). Cow sharks are ovoviviparous (aplacental viviparous), and lack a yolk-sac placenta.

These sharks are apparently not implicated in unprovoked attacks on swimmers and divers, though they may bite aggressively during capture and can inflict severe lacerations when handled. One species (broadnose sevengill shark) has attacked divers in aquarium display tanks and two of the cowsharks (broadnose sevengill and bluntnose sixgill sharks) reach sufficiently large size (from 2.9 to 4.7 m) to rank as potentially dangerous to people in the water.

Interest to Fisheries : Cow sharks are relatively unimportant but regular components of shark fisheries and bycatches of other fisheries in temperate and tropical waters, and are taken by line gear, bottom and pelagic trawls, and gill nets. These sharks are excellent for human food and are utilized fresh and dried-salted; they are also processed for fishmeal, oil, and leather. Some species are subject to sports fisheries in shallow waters.

Literature : Garman (1913); Daniel (1928); Fowler (1941); Bigelow & Schroeder (1948); Garrick & Schultz (1963); Springer & Waller (1969); Garrick & Paul (1971); Bass, d'Aubrey & Kistnasamy (1975c).

Remarks : The genus Heptranchias is morphologically divergent from other members of Hexanchidae and has sometimes been placed in its own family, Heptranchidae (Compagno, 1973c).

Key to Genera and Species :

1a. Six pairs of gill openings (Fig. 1) (Hexanchus)

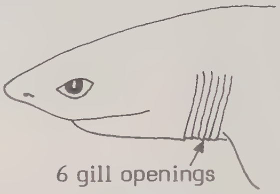
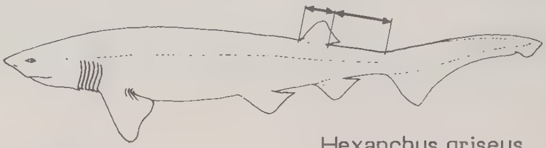


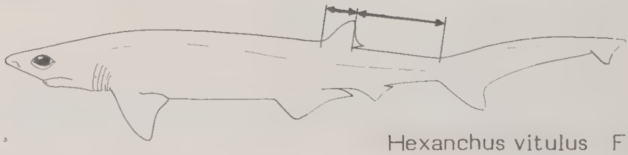
Fig. 1

- 2a. Snout shorter, blunt and broad; lower jaw with 6 rows of large, comblike anterolateral teeth on each side; Dorsal fin base separated from upper caudal fin origin by a distance about equal to or slightly greater than its length. Size very large, up to 4.7 m total length (Fig. 2) - Broadnose sixgill shark .... **Hexanchus griseus**



Hexanchus griseus Fig. 2

- 2b. Snout longer, more pointed and narrow; lower jaw with 5 rows of large, comblike anterolateral teeth on each side; dorsal fin base separated from upper caudal fin origin by a distance much greater than its length. Size smaller, up to 1.8 m total length (Fig. 3) - Bigeye sixgill shark .... **Hexanchus vitulus**



Hexanchus vitulus Fig. 3

1b. Seven pairs of gill openings (Fig. 4)

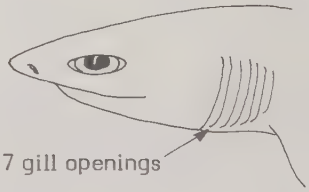
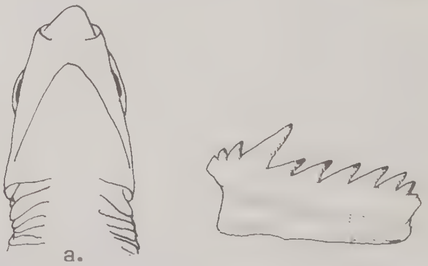


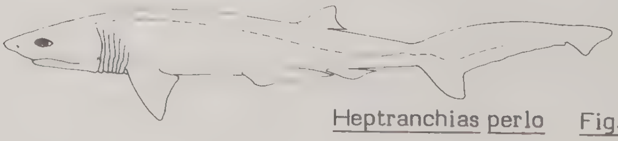
Fig. 4

- 3a. Eyes very large, head extremely narrow and pointed (Fig. 5a); comblike lower anterolateral teeth long and low, with a short cusplet anteromedial to the long main cusp, and a series of abruptly smaller cusplets posterolateral to the cusp (Fig. 5b). Body plain, without spots; size small, to about 1.4 m total length (Fig. 6) - Sharpnose sevengill shark .... **Heptranchias perlo**


a. underside of head

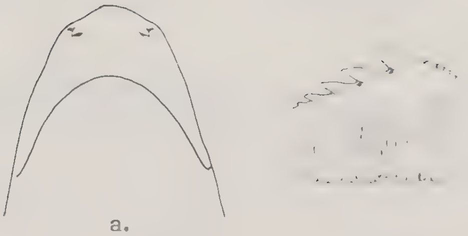
b. tooth

Fig. 5



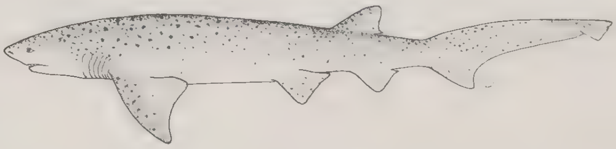
Heptranchias perlo Fig. 6

3b. Eyes small, head broad and rounded (Fig. 7a); comblike lower anterolateral teeth high and short, with a set of serrations anteromedial to the short main cusp, and a series of gradually smaller cusplets posterolateral to the cusp (Fig. 7b). Body usually with scattered small black spots and sometimes white spots also; size larger, to about 2.9 m total length (Fig. 8) - Bluntnose sevengill shark .... **Notorynchus cepedianus**


a. underside of head

b. tooth

Notorynchus cepedianus Fig. 7


Notorynchus cepedianus Fig. 8

Heptranchias Rafinesque, 1810

HEX Hept

Genus : Heptranchias Rafinesque, 1810, Caratt.gen.sp.anim.piant.Sicilia, Palermo, Pt. 1:13. Type Species: Squalus cinereus Lacepède by original designation, equals Squalus cinereus Gmelin, 1789 and a junior synonym of Squalus perlo Bonnaterre, 1788.

Synonymy : Genus Heptanchus Müller & Henle, 1837; Genus Heptranchus Gray, 1851; Genus Heptrancus Costa, 1857.

Diagnostic Features : Head narrow and pointed, with 7 pairs of gill slits; eyes very large; mouth very narrow and parabolic; large lower comblike teeth long and low, with a few short mesial cusplets, an abruptly high cusp, and up to 7 or 8 distal cusplets in adults. Caudal peduncle long, distance from dorsal fin insertion to upper caudal origin over twice length of dorsal fin base. Colour: spots absent from body, dorsal fin and upper caudal lobe with black tips, faded or absent in adults but prominent in young.

Remarks : Following Garrick & Paul (1971) and Bass, d'Aubrey & Kistnasamy (1975c), only a single species is recognized for this genus, H. perlo (Bonnaterre, 1788).

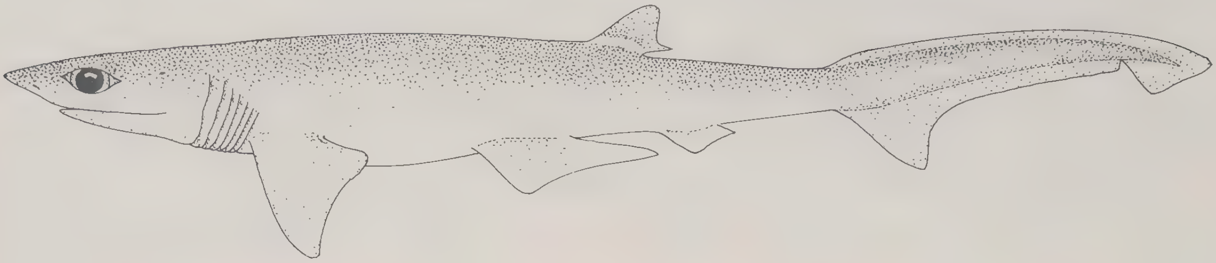
Heptranchias perlo (Bonnaterre, 1788)

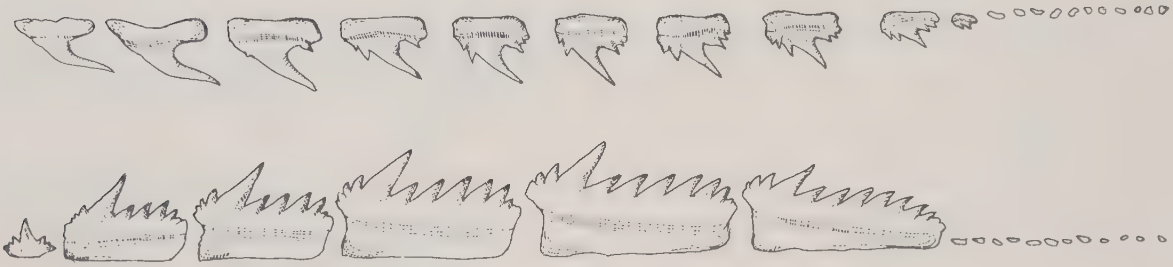
HEX Hept 1

Squalus perlo Bonnaterre, 1788, Tabl.encyclop.method.trois reg.Nat., Ichthyol., Paris, 10. Holotype: Unknown. Type Locality: Mediterranean Sea.

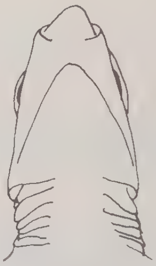
Synonymy : Squalus cinereus Gmelin, 1789; Heptranchias angio Costa, 1857; Notidanus (Heptanchus) cinereus, var. pristiurus (var. aetatis) Bellotti, 1877; Heptranchias deani Jordan & Starks, 1901; Heptranchias dakini Whitley, 1931.

FAO Names : En - Sharpnose sevengill shark; Fr - Requin perlon; Sp - Cañabota bocadulce.





upper and lower teeth of left side



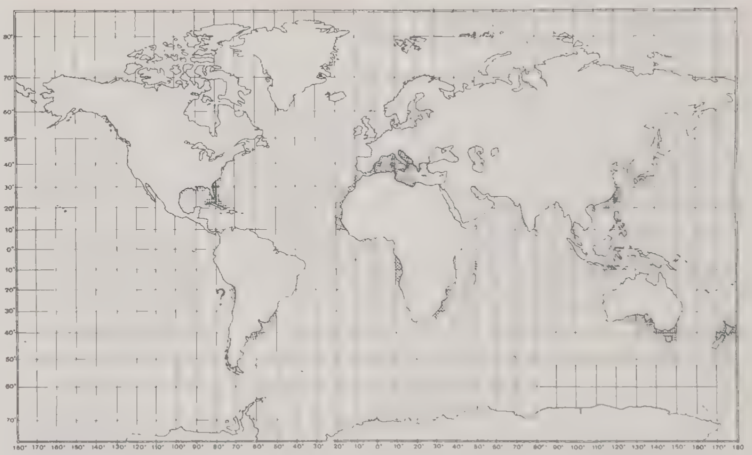
underside of head

Field Marks : A narrow-headed, big-eyed, small seven-gilled shark with one dorsal fin.

Diagnostic Features : See genus Heptranchias.

Geographical Distribution : Wide-ranging in tropical and temperate seas; Western Atlantic: North Carolina, USA to Cuba and northern Gulf of Mexico, also southern Brazil and Argentina. Eastern Atlantic: From Morocco to Angola, also Mediterranean Sea. Indian Ocean: South Africa, southern Mozambique, Aldabra Island, southwestern India. Western Pacific: Japan (southeastern Honshu) and southern Sea of Japan to China, also Indonesia (Bali), Australia (New South Wales, Victoria, Tasmania, South Australia) and New Zealand. Eastern Pacific: off northern Chile.

Habitat and Biology : Marine and benthic, on the continental and insular shelves and upper slopes; depth usually between 27 to 720 m, but sometimes in shallower water close inshore and down to 1000 m.



A primarily deepwater species, probably strong-swimming. Ovoviviparous, number of young 9 to 20 in a litter. Feeds on bony fishes, including hake, and squid. Very active and aggressive when captured and quick to bite, but too small to be very dangerous to people.

Size : Maximum total length about 137 cm, size at birth about 26 cm, size at maturity about 85 cm, for males and 89 to 93 cm for females; said to reach 214 cm, but possibly in error.

Interest to Fisheries : Generally caught in some numbers as a bycatch of fisheries utilizing bottom trawls and longlines, but of small importance.

Literature : Bigelow & Schroeder (1948), Garrick & Paul (1971), Bass, d'Aubrey & Kistnasamy (1975c).

Remarks : This species was recently discovered off Quilon, southwestern India (Compagno & Talwar, 1982, in press), and off Bali, Indonesia (T. Gloerfelt-Tarp, pers.comm.).

Hexanchus Rafinesque, 1810 HEX Hex

Genus : *Hexanchus* Rafinesque, 1810, *Caratt.gen.sp.anim.piant.Sicilia, Palermo*, Pt. 1:14. Type Species : *Squalus griseus* Lacepède, by original designation, equals *Squalus griseus* Bonnaterre, 1788.

Synonymy : Subgenus *Monopterhinus* Blainville, 1816 (genus *Squalus* Linnaeus, 1758); Subgenus *Notidanus* Cuvier, 1817 (genus *Squalus* Linnaeus, 1758); Genus *Hexanchias* Swainson, 1838; Genus *Notidamus* Münster, 1842; Genus *Hexancus* Agassiz, 1846.

Diagnostic Features : Head broad or narrow and pointed, with 6 pairs of gill slits; eyes small to large; mouth narrow and parabolic or wide and arcuate; large lower comblike teeth low and long, with mesial serrations, a low to moderately high cusp, and 8 to 10 distal cusplets in adults; caudal peduncle short to long, distance from dorsal fin insertion to upper caudal origin varying from slightly longer to about twice as long as dorsal base; body without spots, no black tips on fins.

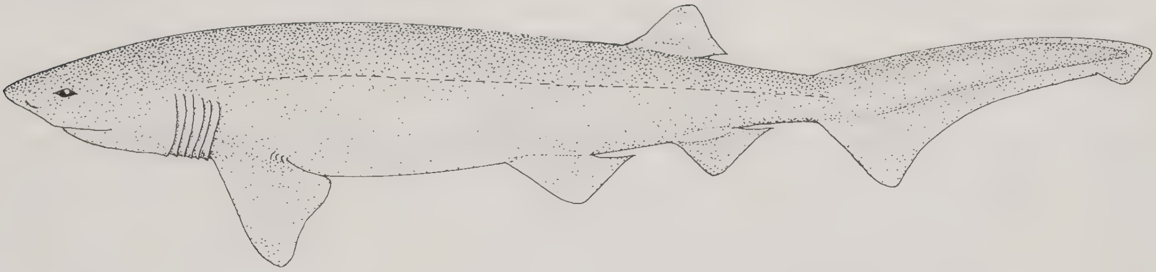
Remarks : Following Springer & Waller (1969), two species are recognized for this genus, *H. griseus* (Bonnaterre, 1788) and *H. vitulus* Springer & Waller, 1969.

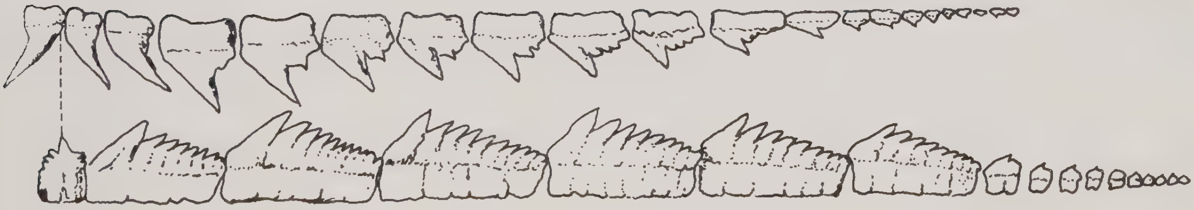
Hexanchus griseus (Bonnaterre, 1788) HEX Hex 1

Squalus griseus Bonnaterre, 1788, Tabl.encyclop.method.trois reg.Nat., *Ichthyol., Paris*, 9. Holotype: Unknown. Type Locality: Mediterranean Sea.

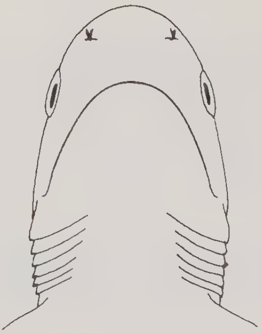
Synonymy : *Squalus vacca* Bloch & Schneider, 1801; *Notidanus monge* Risso, 1826; *Hexanchus corinus* Jordan & Gilbert, 1880; *Notidanus vulgaris* Perez Canto, 1886; *Hexanchus griseus australis* De Buen, 1960.

FAO Names : En - Bluntnose sixgill shark; Fr - Requin griset (= Requin grisé, Fishing Area 34/47 in part); Sp - Cañabota gris.





teeth of left side

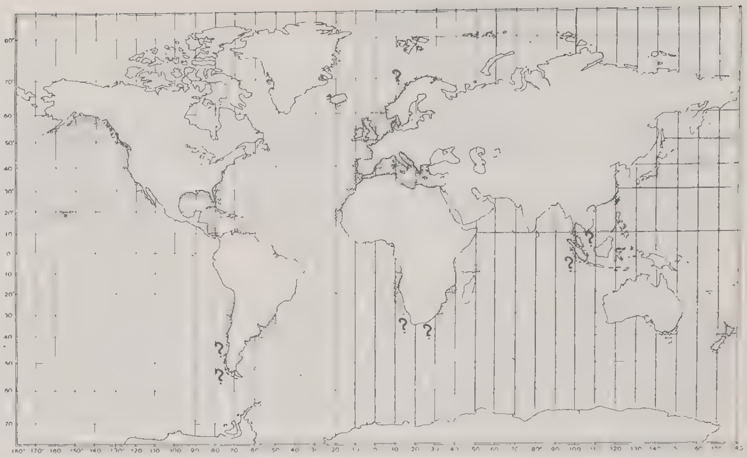


underside of head

Field Marks : A heavy-bodied, broad-headed sixgill shark, mouth ventral with 6 rows of lower bladelike, comb-shaped teeth on each side, one dorsal fin.

Diagnostic Features : Body rather stout; size very large, to at least 4.8 m. Head broad and rounded to bluntly pointed; eyes small; lower jaw usually with 6 rows of large, comblike teeth on each side, these with relatively short cusps. Caudal peduncle short and stout, distance from dorsal fin insertion to upper caudal origin about equal or slightly greater than length of dorsal fin base.

Geographical Distribution : Wide-ranging in temperate and tropical seas. Western Atlantic: North Carolina to Florida, USA, northern Gulf of Mexico, Cuba, Nicaragua, Costa Rica, Venezuela, also southern Brazil to northern Argentina. Eastern Atlantic: from Iceland, Norway to Senegal, possibly Ivory Coast and Nigeria, Angola and Namibia, also Mediterranean Sea. Indian Ocean: Off South Africa, southern Mozambique, Madagascar, Aldabra Island group, Comores Islands. Western Pacific: Japan (eastern coast), Taiwan (Province of China), Malaysia, Sumatra, Australia (New South Wales and Victoria), New Zealand. Central Pacific: Hawaiian Islands, Palau (Belau). Eastern Pacific: from Aleutian Islands, USA, to Baja California, Mexico, also Chile.



Habitat and Biology : Marine and benthic or pelagic, on the continental and insular shelves and upper slopes, depths from surface to at least 1875 m. Young often close inshore, adults often in deeper water below 91 m. A mostly deepwater shark, sluggish but strong-swimming; found near and well off the bottom. Captive individuals become greatly disturbed at even moderately high light levels, indicating a great sensitivity to light at very low levels. Large individuals offer little resistance when captured, but small ones may snap and thrash vigorously. It may sit on the bottom by day, and rise to the surface at night to feed. Feeds on a wide range of marine organisms, including other sharks (known to attack hooked conspecifics, sometimes following them up to the surface from deep water), rays, chimaeras, many types of bony fishes including dolphinfishes, small swordfish and marlin, herring, grenadiers, cod, ling, hake, flounders, gurnards and anglers, as well as squids crabs, shrimp, carrion, and even seals. Ovoviviparous, litters very large, 22 to 108. Not known to have attacked people without provocation; young will snap when captured.

Size : Maximum total length at least 482 cm, females mature at about 450 to 482 cm, size at birth about 65 to 70 cm.

Interest to Fisheries : Locally common and taken by line gear, gillnets, traps and pelagic and bottom trawls; utilized fresh, frozen, dried salted for human consumption, and for fishmeal and oil.

Literature : Bigelow & Schroeder (1948); Springer & Waller (1969); Bass, d'Aubrey & Kistnasamy (1975c); D. Ebert & B. Saunders (pers.comm.).

Remarks : I follow Springer & Waller (1969) in including Hexanchus corinus in synonymy of H. griseus. The account of H. griseus australis by De Buen (1960) indicates that this subspecies differs from typical H. griseus in having only 5 rows of large, comblike anterolateral teeth on each side of the lower symphysis and a more elongated, more prominent ventral caudal lobe (H. griseus with 6 rows of comblike lower anteral teeth on each side and with a weak ventral caudal lobe). H. vitulus also differs from typical H. griseus in having a stronger ventral caudal lobe and only 5 rows of comblike lower anterolateral teeth, but other descriptive information and measurements in De Buen (1960) indicate that H. griseus australis has fin and body proportions and lower teeth otherwise similar to typical H. griseus rather than H. vitulus. The taxonomic position of H. griseus australis is dubious at present, because the holotype of this subspecies and other De Buen species from deep water off Chile were apparently lost (J.D. McEachran, pers.comm.). I have been unable to examine Hexanchus material from Chile and tentatively rank H. griseus australis in synonymy of H. griseus without recognizing it as a subspecies.

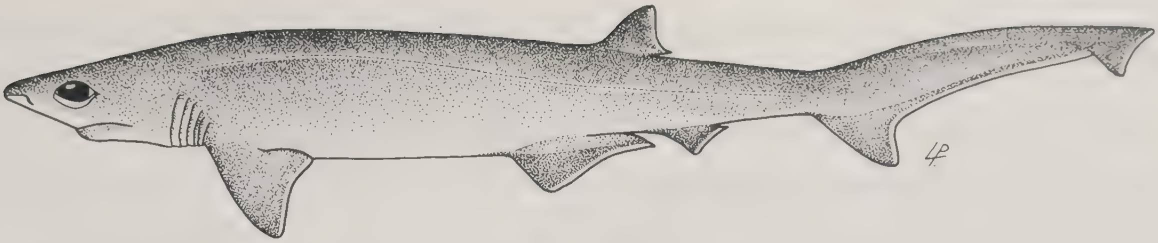
Hexanchus vitulus Springer & Waller, 1969

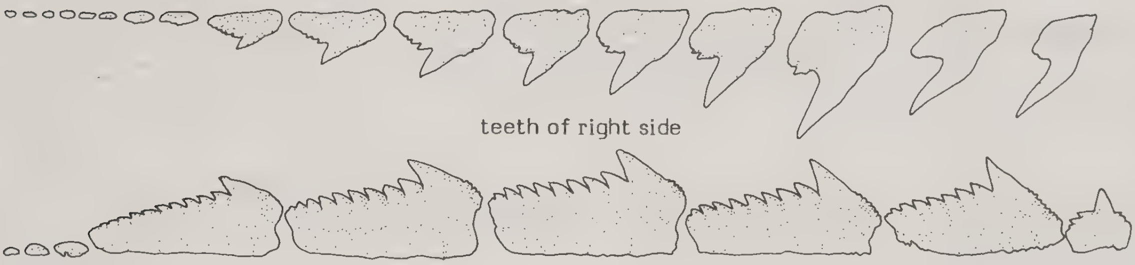
HEX Hex 2

Hexanchus vitulus Springer & Waller, 1969, Bull.Mar.Sci., 19(1):160, figs 1, 2A, 3-4. Holotype: U.S. National Museum of Natural History, USNM 200674, 148 cm adult male caught off Bimini, Bahamas, in about 350 m depth.

Synonymy : Hexanchus griseus nakamurai Teng, 1962 (see remarks below).

FAO Names : En - Bigeyed sixgill shark; Fr - Requin vache; Sp - Cañabota ojigrande.

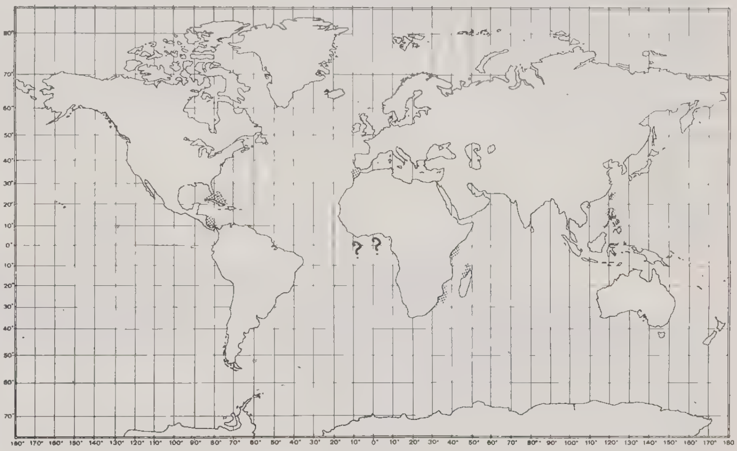




teeth of right side

Field Marks : A slender-bodied, narrow-headed sixgill shark, mouth ventral with 5 rows of lower bladelike, comb-shaped teeth on each side, one dorsal fin.

Diagnostic Features : Body rather slender; size moderate, up to 1.8 m long. Head narrow and pointed; eyes large; lower jaw with 5 rows of large, comblike teeth on each side, these with relatively long cusps. Caudal peduncle long and slender, distance from dorsal fin insertion to upper caudal origin at least twice length of dorsal fin base.



Geographical Distribution : Widely but spottily distributed in warm temperate and tropical seas; in the western North Atlantic: off the Bahamas, northern Cuba, Nicaragua, and Costa Rica; eastern Atlantic: off Gibraltar and possibly Ivory Coast and Nigeria; Indian Ocean: off southern Africa, Aldabra Island (India), Madagascar and Kenya; western Pacific, off Taiwan Island and the Philippines (Luzon).

Habitat and Biology : Continental and insular shelves and slopes from 90 to 600 m depth, usually on or near bottom, but occasionally at the surface in the tropics.

A little-known, primarily deepwater shark. Ovoviviparous, number of young 13 in one litter. Eats small to medium-sized fishes, and probably bottom invertebrates. Not dangerous to people as far as is known.

Size : Maximum total length about 180 cm, length at birth about 43 cm, females mature at 142 to 178 cm, males at 123 to 157 cm.

Interest to Fisheries : Apparently uncommonly taken on line gear and in trawls and of relatively slight importance to fisheries.

Literature : Bigelow & Schroeder (1948); Teng (1962); Chen (1963); Springer & Waller (1969); Forster et al. (1970); Bass, d'Aubrey & Kistnasamy (1975c).

Remarks : Specimem of this species were listed and illustrated as H. griseus by Nakamura (1936, pl. 1, fig. 1) from Taiwan Island. Teng (1962) described a new Taiwanese subspecies, H. griseus nakamurai, based on two specimens from Keelung: Taiwan Fisheries Research Institute No. 2515, 750 mm juvenile male, designated as its holotype, and no. 3280, 970 mm female, designated as paratype. Teng also described and illustrated typical H. griseus from Taiwan as H. g. griseus. Springer & Waller (1969) described the new H. vitulus but failed to mention Nakamura's and Teng's earlier accounts.

Comparison of the original descriptions of H. griseus nakamurai and of H. vitulus strongly suggests that the two are synonyms. I retain H. vitulus because the question exists as to whether Teng's (1962) work was actually published and if his names are available. It has been cited as a publication by Chen (1963) and Springer (1979), but may be an unpublished Ph.D thesis (Dr S.C. Shen, pers.comm. to Dr P.C. Heemstra). Chen (1963:1) stated that "Hexanchus griseus nakamurai n.subsp." was a synonym of H. griseus, and under that species (p. 6) listed nakamurai as a synonym. If Teng's name is not available from his 1962 monograph, it is an open question whether its citation in Chen establishes it beyond the status of nomen nudum.

Notorynchus Ayres, 1855

HEX Not

Genus : *Notorynchus* Ayres, 1855, *Proc.California Acad.Sci.*, 1:77.

Type Species : *Notorynchus maculatus* Ayres, 1855, by original designation, equals *Squalus cepedianus* Peron, 1809.

Synonymy : Genus *Notorhynchus* Gill, 1864 (emended spelling).

Diagnostic Features : Head broad and rounded or bluntly pointed, with 7 pairs of gill slits on head; eyes small; mouth wide and arcuate; large lower comblike teeth high and short, with mesial serrations, a low cusp, and 5 or 6 distal cusplets in adults. Caudal peduncle short, distance from dorsal fin insertion to upper caudal origin about equal to length of dorsal base. Colour: body usually with numerous small black spots, but dorsal fin and upper caudal lobe without black tips.

Notorynchus cepedianus (Peron, 1807)

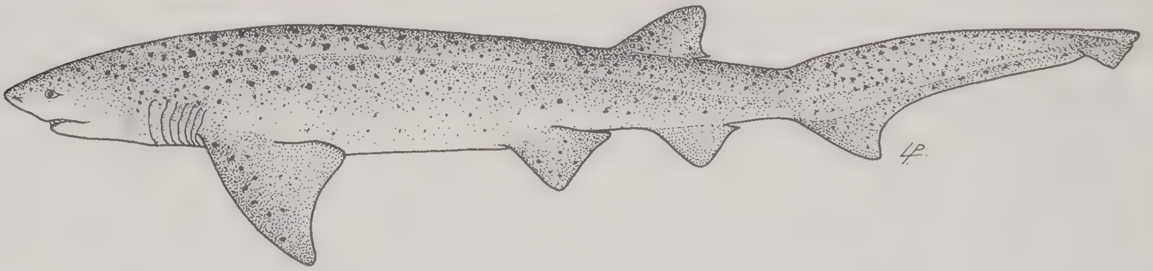
HEX Not 1

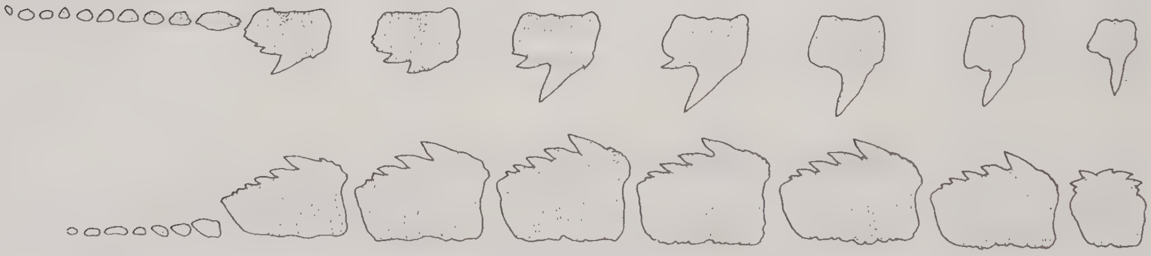
Squalus cepedianus Peron, 1807, *Voy.Australes*, 1:337. Holotype: Unknown. Type Locality: Adventure Bay, Tasmania.

Synonymy : *Notidanus indicus* Agassiz, 1835; *Notorynchus maculatus* Ayres, 1855; *Notorhynchus borealis* Gill, 1864; *Heptranchias pectorosus* Garman, 1884; *Notidanus ferox* Perez Canto, 1886; *?Heptranchias haswelli* Ogilby, 1897; *Notidanus medinae* Philippi, 1901; *Notidanus wolniczkyi* Philippi, 1901; *Heptranchias spilotus* Lahille, 1913; *Notorhynchus ocellatus* Devincenci, 1920; *Notorynchus macdonaldi* Whitley, 1931.

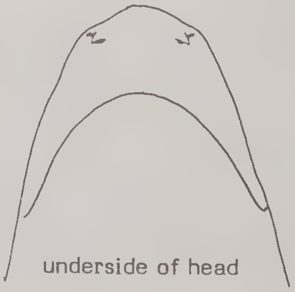
Other Scientific Names Recently in Use : *Notorynchus pectorosus* (Garman, 1884).

FAO Names : En - Broadnose sevengill shark; Fr - Platnez; Sp - Cañabota gata.





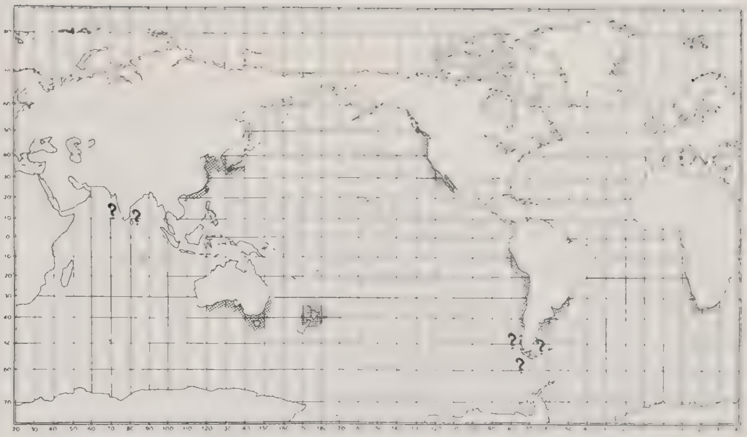
teeth of right side



underside of head

Field Marks : A broad-headed, small-eyed, large seven-gilled shark with one dorsal fin and usually small, numerous black spots on body.

Diagnostic Features : See genus.



Geographical Distribution : Wide-ranging in mostly temperate seas. Western South Atlantic: From southern Brazil to northern Argentina. Eastern South Atlantic and Western Indian Ocean: From Namibia, southern Africa to India. Western Pacific: From southern Japan, the Koreas, China, also Australia (New South Wales, Victoria, Tasmania, South Australia), and New Zealand. Eastern Pacific: From British Columbia, Canada to southern California, USA, Gulf of California, Mexico, also from Peru to central Chile.

Habitat and Biology : Marine and benthic, neritic, on the continental shelves; depth to at least 46 m, but often shallow water less than 1 m deep and at the surface. A coastal shark, common in shallow bays and close to shore, often caught at the surfline, but with larger individuals ranging into deeper water offshore and deep channels in bays. Active and strong-swimming, often found cruising steadily and slowly near the bottom but sometimes at the surface; can dash at speed when attacking prey. Apparently coordinates its movements in bays with the tidal cycle, moving in with a tidal rise and out with its fall.

Ovoviviparous but with reproduction little known; litters large, up to 82 young. Gravid females apparently drop their young in shallow bays.

A powerful predator, rather indiscriminate in its feeding habits; may prefer other sharks (including spiny dogfish, houndsharks, and also hooked conspecifics which it readily attacks) and rays (eagle rays commonly taken), also bony fishes (Pacific salmon, sturgeon, herring, anchovies, and probably many others) and carrion (including porpoise, dolphin, rats, and even human flesh). Aggressive when provoked, and regarded as potentially dangerous to people in open waters. It has attacked divers in captivity, and may have been involved in a few shark attacks off California and South Africa; however, verified attacks by this species on people in open waters have not been recorded. It vigorously snaps and thrashes when captured by fishermen, and is often subdued by firearms or powerheads before being boated.

Size : Maximum total length about 290 cm and possibly between 3 and 4 m; an old record at 4.6 m was based on Hexanchus griseus. Size at birth between 45 and 53 cm; males maturing between 150 and 180 cm and reaching at least 226 cm; females maturing between 192 and 208 cm and reaching at least 288 cm.

Interest to Fisheries : The large size, local abundance and high-quality flesh of this shark makes it the subject of fisheries in several areas where it occurs. In California, USA and southern Australia it is fished by sport and commercial fishermen for human consumption, but it is also utilized in China for its skin, which produces leather of good quality, and its liver, which yields oil with high concentrations of Vitamin A. It is fished with rod and reel and longline gear, on the bottom. In California fishermen capture it from boats at moderate depths (down to at least 30 m), but on the Cape coast, South Africa, sports fishermen commonly hook it from shore.

Literature : Whitley (1940); Fowler (1941); Roedel & Ripley (1950); Kato, Springer & Wagner (1967); Hart (1973); Bass, d'Aubrey & Kistnasamy (1975c); D. Ebert, B. Welton & J. Burton (pers.comm.).

Remarks : I follow Bass, d'Aubrey & Kistnasamy (1975c) and Kemp (1978) in tentatively recognizing a single species of Notorynchus, N. cepedianus. The characters used by Fowler (1941) to separate N. pectorosus from N. cepedianus (presence of a medial tooth on the upper symphysis and serrations on the premedial or symphyseal edge of the lower comblike anterolateral teeth of the former, and absence of a medial tooth on the upper symphysis and serrations weak or absent in the latter) apparently are the result of individual variation within a single species (Kemp, 1978; also from series of Notorynchus specimens from San Francisco Bay, California, USA, examined by the writer).

The identity of the species of Notorynchus from Indian waters needs to be confirmed. This is often accorded a separate species, N. indicus (Agassiz, 1835), but this is not separable from N. cepedianus using available data on the species. I tentatively include it in N. cepedianus pending new information clarifying its status. A visit to India by the writer in 1982 revealed no extant material of Notorynchus in collections, but uncovered the first record of Heptranchias perlo from India (Compagno & Talwar, 1982, in press). It is possible that records of Notorynchus from India are erroneous (P.K. Talwar, pers.comm.).

3. ORDER SQUALIFORMES - DOGFISH SHARKS

Order Squaliformes Compagno, 1973c, J.Linn.Soc.(Zool.), Lond., 53, suppl. 1.

Synonymy : Order Cyclospondyli: Jordan & Evermann, 1896, Fowler, 1941, Smith, 1949. Order Euselachii, Suborder Squaloidea: Blot, 1969 (in part). Suborder Galei: Gill, 1872 (in part). Order Lamniformes, Suborder Squaloidei: Patterson, 1967 (in part). Suborder Plagiostomi Cyclospondyli: Hasse, 1879. Order Squalea, Suborder Squalida: White, 1936, 1937 (in part). Suborder Squali: Gill, 1862 (in part). Order Squaliformes: Rass & Lindberg, 1971, Applegate, 1974, Chu & Wen, 1979. Order Squaliformes, Suborder Squaloidei: Berg, 1940 (in part), Berg & Svedovidov, 1955 (in part), Arambourg & Bertin (1958) (in part). Suborder Squaliformes: Goodrich, 1909 (in part), Lozano y Rey, 1928, Bertin, 1939 (in part), Budker & Whitehead, 1971. Suborder Squalina: Matsubara, 1955, Fowler, 1968a. Order and Suborder Squaloidea: Schultz & Stern, 1948. Suborder Squaloidea: Romer, 1945, 1966 (in part), Bigelow & Schroeder, 1948, Norman, 1966. "Division" Squaloidei: Regan, 1906 (in part). "Group" Squaloidei: Garman, 1913 (in part). Suborder Squaloidei: Engelhardt, 1913 (in part), Lindberg, 1971, Nelson, 1976. Order Squatiniformes, Suborders Echinorhinoidei and Squaloidei: Glikman, 1967. Order Tectospondyli: Gill, 1893, Whitley, 1940. Order Tectospondyli, Suborder Squaloidei: Jordan 1923.

Field Marks : Cylindrical or compressed body, not raylike, 5 gill slits, 2 dorsal fins, no anal fin, snout normal, not sawlike.

Diagnostic Features : Trunk cylindrical, slightly depressed or somewhat compressed, not flattened and raylike. Head conical to depressed, not expanded laterally; five pairs of gill slits present on sides of head, with the posteriormost in front of pectoral fin origins; spiracles present and small to very large, well behind or close behind eyes and often above level of eyes; nostrils without nasoral grooves or circumnarial grooves, separate from mouth, anterior nasal flaps usually short and not reaching mouth, expanded into barbels in one genus (Cirrhigaleus) but without separate barbels on their outer edges; eyes on sides of head, without nictitating lower eyelids; snout short to long, flattened or conical, not greatly elongated into a flattened blade with lateral teeth and rostral barbels; mouth moderately large to short, arched and elongated to nearly transverse, below eyes; labial furrows well-developed, short to very long, on both jaws; teeth only moderately differentiated along the jaws, without enlarged anterior or posterior teeth and without a gap or small intermediate teeth between anterior and lateral teeth in the upper jaw. Two dorsal fins, with or without fin spines (Squaliolus with a spine on the first dorsal only), the first with origin varying from over the pectoral bases or gill slits to over the anterior halves of the pelvic bases; pectoral fins small to moderately large, not expanded and raylike, without triangular anterior lobes that cover the gill slits; pelvic fins small to moderately large, with vent continuous with their inner margins; anal fin absent; caudal fin with a long to moderate-sized dorsal lobe and the ventral lobe long to absent but always shorter than the dorsal lobe when present; vertebral axis elevated into the dorsal caudal lobe. Intestinal valve of spiral type.

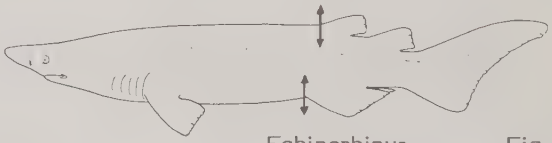
Key to Families :

1a. First dorsal fin originating behind pelvic fin origins (Fig. 1) - Bramble sharks .... **Family Echinorhinidae**
(one genus, Echinorhinus)

1b. First dorsal fin originating in front of pelvic fin origins (Fig. 2)

  2a. Body very high and compressed, triangular in cross-section; dorsal fins extremely high (Fig. 3) - Rough sharks ...... **Family Oxynotidae**
  (one genus, Oxynotus)

  2b. Body low and more cylindrical in cross-section; dorsal fin low (Fig. 4) - Dogfish sharks .... **Family Squalidae**
  (see key to genera)


Echinorhinus Fig.1

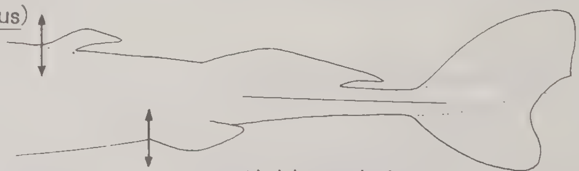
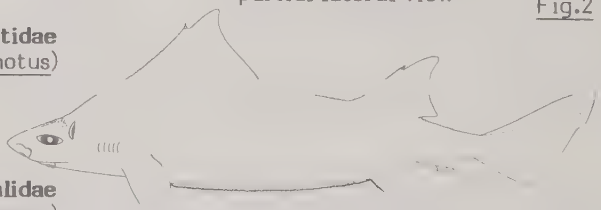
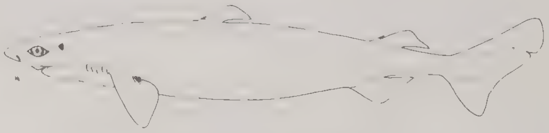


Fig.2


Oxinotus Fig.3


Centroscymnus Fig.4

3.1 FAMILY ECHINORHINIDAE Gill, 1862

ECHIN

Echinorhinoidae Gill, 1862, Ann.Lyceum Nat.Hist.N.Y., 7:406.

Synonymy : None.

FAO Names : En - Bramble sharks; Fr - Squales bouclés; Sp - Tiburones espinosos.

Field Marks : Short-nosed, cylindrical sharks with no anal fin, 2 very small, spineless, posterior dorsal fins, the first behind the pelvic origins, and coarse denticles or enlarged thorns.

Diagnostic Features : Trunk stout and cylindrical, without abdominal ridges. Head moderately depressed; last (5th) gill slits abruptly expanded in width; spiracles very small, well behind eyes; nostrils far apart from each other; mouth broadly arched, with very short labial furrows that do not encircle mouth; lips not papillose; teeth alike in both haws, strongly compressed and bladelike, with a cusp and up to three side cusplets in adults, but with a cusp only in young. Two small spineless dorsal fins, both smaller than the pelvic fins, the first with its base over the pelvic bases; caudal fin without a subterminal notch.

Habitat, Distribution and Biology : This family includes two uncommon species of large, poorly known wide-ranging, deepwater sharks in cold-temperate to tropical seas. They have a spotty but virtually circumglobal distribution on continental and insular shelves and slopes from 11 to 900 m depth, on or near the bottom. Bramble sharks reach a maximum size of 3 to 4 m. They feed on a variety of benthic and neritic fishes, including other sharks, ling, hake, flatfishes, lingcod, lizardfishes, rockfishes, topsmelt, herring, and elephantfishes (Callorinchus), as well as crabs, octopuses and squids. They have a moderate-sized mouth and a very large pharynx, and are thought to suck in their prey by suddenly expanding their mouths and pharynxes when in range. They are very sluggish, harmless sharks, never recorded as attacking people. Bramble sharks are ovoviviparous and lack a yolk-sac placenta.

Interest to Fisheries : Although these sharks attain a large size (3 to 4 m maximum total length), they are uncommon to rare in most areas where they occur and hence are of minimal interest to fisheries. They generally occur as a bycatch of other fisheries, including those for other sharks, and are taken on line gear, deepset gillnets, and more commonly in bottom trawls. They are used for fishmeal and medicinal purposes.

Remarks : This family is sometimes placed as a synonym of Squalidae, but morphological study indicates that it is very distinct from the Squalidae. It has a single living genus, Echinorhinus.

Echinorhinus Blainville, 1816

ECHIN Echin

Subgenus Echinorhinus Blainville, 1816 (genus Squalus), Bull.Soc.Philomat.Paris, 8:121.

Type Species : "spinosus" (Squalus spinosus Gmelin, 1789), by monotypy, equals Squalus brucus Bonnaterre, 1788.

Synonymy : Genus Goniodus Agassiz, 1838; Subgenus Rubusqualus Whitley, 1931 (Genus Echinorhinus); Genus Echynorhynus Nobre, 1935 (error or emendation).

Remarks : I follow Garrick (1960) in recognizing two species in this genus.

Key to Species :

1a. Denticles of body numerous, close-packed, relatively small, stellate, and not fused into plates with multiple cusps .... **E. cookei**

1b. Denticles of body few, sparse, relatively large, not stellate, and with some fused into plates with multiple cusps .... **E. brucus**

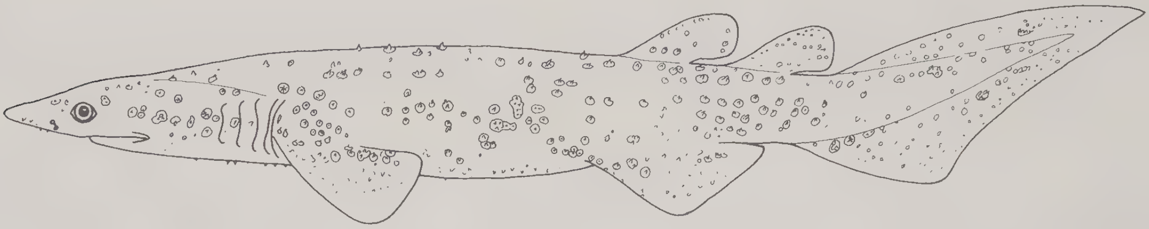
Echinorhinus brucus (Bonnaterre, 1788)

ECHIN Echin 1

Squalus brucus Bonnaterre, 1788, Tabl.encyclop.method.trois reg.Nat., Ichthyol., Paris, 11. Holotype: lost. Type Locality: "L'Océan" (eastern North Atlantic).

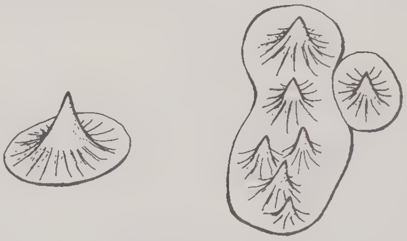
Synonymy : Squalus spinosus Gmelin, 1789; Echinorhinus obesus Smith, 1849; Echinorhinus (Rubusqualus) mccoyi Whitley, 1931.

FAO Names : En - Bramble shark; Fr - Squale bouclé; Sp - Tiburón de clavos.

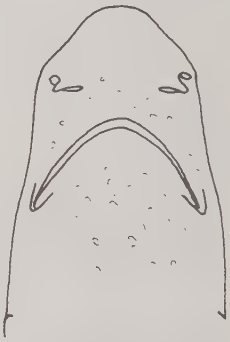


Field Marks : No anal fin, dorsals spineless and far back, first behind pelvic origins, large scattered thornlike denticles on body and fins.

Diagnostic Features : Dermal denticles on body and fins varying from small to very large, with many large, widely spaced, thorn or buckler-like denticles with bases not stellate and over a centimetre wide; some of these large denticles are fused in groups of 2 to 10 and may form large plates over 25 mm across.



dermal denticles



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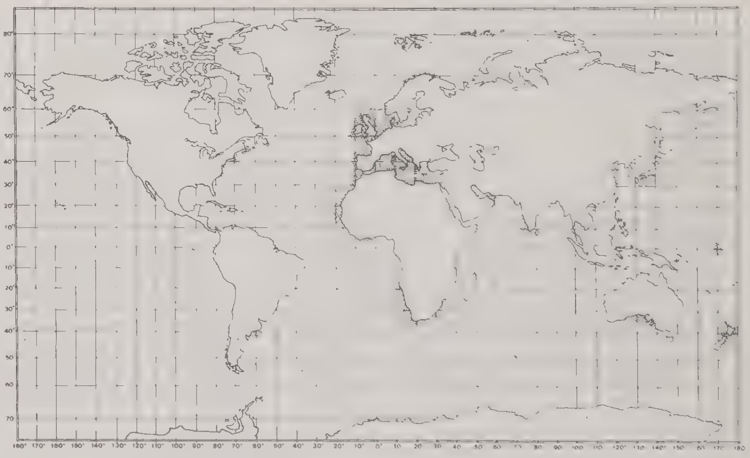
Geographical Distribution : Western Atlantic: Virginia, Massachusetts, USA; Argentina. Eastern Atlantic: Scottish and Irish Atlantic Slopes and North Sea to Mediterranean, Morocco, Canary Islands, Senegal, Ivory Coast; Namibia to Cape of Good Hope, South Africa. Western Indian Ocean: South Africa, southern Mozambique, ?Oman, India. Western Pacific: Japan (southeastern Honshu), Australia (South Australia), New Zealand, ?Kiribati.



Habitat and Biology : A large, sluggish bottom shark sometimes occurring in shallow water but primarily a deepwater species, occurring on the continental and insular shelves and upper slopes at depths from 18 to 900 m. Ovoviviparous, number of young per litter from 15 to 24; may breed in April in Indian waters. Eats smaller sharks (spiny dogfish), bony fishes (including ling, catfish, and lizardfish), and crabs.

Size : Maximum total length about 3.1 m. Young born between 29 and 90 cm, adult females reported at 213 to 230 cm, adult males reported at 150 to 174 cm.

Interest to Fisheries : Apparently relatively common only in the eastern Atlantic, especially from the North Sea to Portugal, where it is caught in bottom trawls and on line gear. Utilized in the eastern Atlantic for fishmeal; liver oil has high value for medicinal purposes in South Africa. Relatively unimportant as a fisheries species.

Literature : Bigelow & Schroeder (1948); Tortonese (1958); Musick & McEachran (1969); Silas & Severaj (1972), Hureau & Monod (1973); Cadenat & Blache (1981).

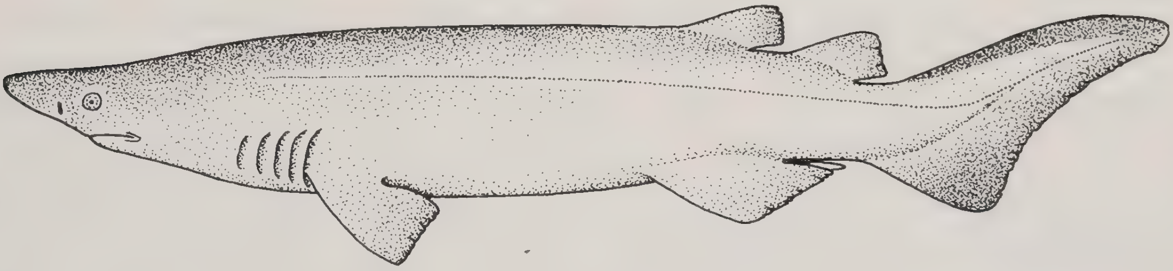
Echinorhinus cookei Pietschmann, 1928

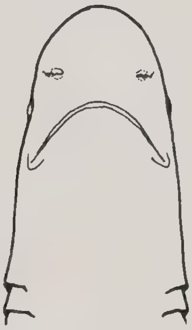
ECHIN Echin 2

Echinorhinus cookei Pietschmann, 1928, Anz.Akad.Wien, 65:297. Holotype: Formerly in Bernice P. Bishop Museum, Oahu, Hawaiian Islands, apparently lost. Type Locality: South coast of Kauai, Hawaiian Islands. Neotype: National Museum of New Zealand, NMNZ 2774, Pallaser Bay, Cook Strait, New Zealand, designated by Garrick (1960:110).

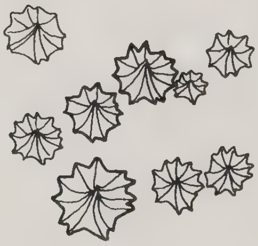
Synonymy : None.

FAO Names : En - Prickly shark; Fr - Squale bouclé du Pacifique; Sp - Tiburón negro espinoso.





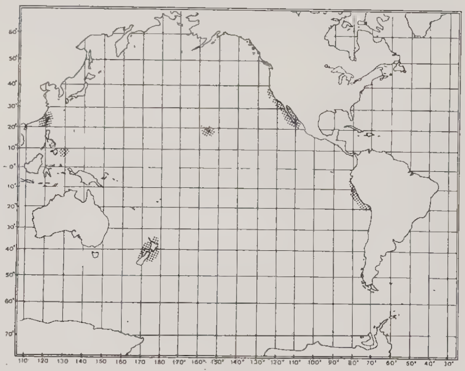
underside of head



dermal denticles

Field Marks : No anal fin, dorsals spineless and far back, first behind pelvic origins; denticles relatively close-set and only moderately large, not formed as large, flat thorns.

Diagnostic Features : Dermal denticles on body moderate-sized, close-set, and with relatively small, stellate bases, less than 5 mm in diameter; denticles not expanded into large bucklers or thorns, not fused together.



Geographical Distribution : Western Pacific: Taiwan (Province of China), New Zealand. Central Pacific: Palau (Belau) and Hawaiian Islands. Eastern Pacific: Central California to Gulf of California, also Peru.

Habitat and Biology : A large, sluggish bottom shark, occurring on continental and insular shelves and upper slopes at depths from 11 to at least 424 m; in California caught in submarine canyons. Eats a variety of fishes, including spiny dogfish, the young of the sixgill shark (Hexanchus griseus), hake, flounders, rockfish, lingcod, topsmelt, herring, elephantfish (Callorinchus), and catshark (Apristurus) eggcases, also octopuses and squids.

Size : Maximum about 4 m, size at birth below 45 cm, mature males reaching at least 220 cm, females immature at 254 cm and adult at 299 cm (sex not reported for 4 m specimen).

Interest to Fisheries : Unimportant, occasionally taken by line gear, gillnets and bottom trawls.

Literature : Garrick (1960); Garrick & Moreland (1968); Varoujean (1972); B. Saunders (pers. comm.).

3.2 FAMILY SQUALIDAE Blainville, 1816

Genus or family *Squalus* Blainville, 1816, *Bull.Soc.Philomat.Paris*, 8:121.

Synonymy : Family Squalinidae Leach, 1818; Family Squalidae Bonaparte, 1832; Subfamily Spinacini Bonaparte, 1838 (Family Squalidae); Subfamily Scymnini Bonaparte, 1838 (Family Squalidae); Family Spinaces Müller & Henle, 1839; Tribe Acantiana Gray, 1851 (Family Squalidae); Tribe Dalatiana Gray, 1851 (Family Squalidae); Family Centrophoroidei Bleeker, 1859; Family Somniosidae Jordan, 1888; Family Scymnorhinidae Gill, *in* Goode & Bean, 1896; Family Isistiidae Garman, 1899; Subfamily Etmopterinae Fowler, 1934 (Family Squalidae); Subfamily Deaniinae Compagno 1973 (Family Squalidae).

FAO Names : Dogfish sharks; Fr - Squales; Sp - Galludos, Tollos.

Field Marks : Short-nosed, cylindrical sharks with no anal fin, 2 dorsal fins with or without spines, the first with origin in front of pelvic origins, and small to moderately large denticles.

Diagnostic Features : Trunk stout to slender but not markedly compressed, with or without low abdominal ridges. Head conical to moderately depressed; last (5th) gill slits may be enlarged but not abruptly expanded from first 4 gill slits; spiracles moderately large to very large, close behind eyes; nostrils usually well apart from each other, separated by a space their width or more; mouth arched or transverse, with short, moderately long, or very long labial furrows that may virtually encircle the mouth; lips usually not expanded and papillose, except for a few dalatiine genera; teeth highly variable, with a cusp always present and cusplets variably present or absent, not bladelike and similar in both jaws, bladelike and more or less similar in both jaws, or bladelike in the lower jaw only and highly divergent in shape from the acute needlelike upper teeth, but never bladelike and with cusplets in both jaws. Two small to moderately large dorsal fins, the first variably smaller or larger than the pelvic fins, with its base at least partly anterior to the pelvic origins and usually well anterior to them; caudal fin with or without a subterminal notch.

Habitat, Distribution and Biology : The dogfish shark include a great variety of small to gigantic sharks, with their greatest diversity in deep water. The Squalidae has a vast geographic and bathymetric range, perhaps greater than any other family or sharks, in all seas from the Arctic to the sub-Antarctic. Most genera and species are found on or near the bottom on the temperate to tropical continental and insular slopes down to at least 3675 m; unidentified members of the genus *Centrophorus* have been seen from a bathyscaphe on the ocean floor at over 6000 m depth. A number of highly diverse small temperate and tropical dogfishes are oceanic and epipelagic, mesopelagic and probably bathypelagic, in some cases making diel vertical migrations that may take them from near the surface to the ocean floor. Among these are some of the smallest of living sharks, of the genera *Squaliolus* and *Euprotomicrus*, that mature at less than 20 cm long. In contrast are two gigantic sleeper sharks in the genus *Somniosus*, attaining a size over 6 m, that are slope-epibenthic sharks in temperate waters but range to the surface and the intertidal in boreal and Arctic waters. Several species of the genus *Squalus* are common on the continental and insular shelves; they may range close inshore in cool temperate waters but are usually epibenthic and well offshore in the tropics, where they may be displaced from inshore habitats by members of the families Carcharhinidae, Sphyrnidae, and other carcharhinoid families.

Some dogfish sharks are solitary, but some species form immense schools that are highly nomadic, moving locally and on regular yearly migrations. All members of this family in which reproduction is known are ovoviviparous (aplacental viviparous), having one or two to over 20 young in a litter. Dogfish feed on a wide variety of prey, chiefly bony fishes but also other sharks, cephalopods, crustacea, other invertebrates, and even marine mammals. Among the dogfishes are the only known chondrichthyian parasites, 'cookie-cutter' sharks of the genus *Isistius*, that eat mesopelagic fishes and squid but are specialized to attach themselves by suctorial lips to the sides of large bony fishes, ceataceans and sharks, and cut out plugs of flesh. Several species apparently feed communally, and may locally exhaust or drive away prey species. Many species have powerful lower cutting dentitions and can dismember large prey. Schools of at least one deepsea lanternshark (*Etmopterus virens*) may attack prey cooperatively, killing deepwater squid too large for an individual shark to overcome. None of the dogfish sharks are very dangerous to people; some species use their mildly toxic finspines or sharp teeth as weapons when captured and can inflict punctures or lacerations on unwary fishermen. None of these sharks have been recently involved in unprovoked attacks on people; there are old, unverified stories of sleeper sharks attacking people in kiyaks, however.

Interest to Fisheries : Species of *Squalus* are taken in large quantities for human consumption and other purposes, but other species, particularly *Centrophorus*, *Centroscymnus*, *Dalatias*, *Deania*, *Scymnodon*, and *Somniosus*, are utilized also. Deepwater species yield liver oil and are processed for fishmeal.

Remarks : The account of Squalidae presented here follows the reviews of Bigelow & Schroeder (1957) and Bass, d'Aubrey & Kistnasamy (1976). Many writers separate the genera *Dalatias*, *Euprotomicroides*, *Euprotomicrus*, *Heteroscymnoides*, *Isistius*, *Scymnodalatias*, *Somniosus*, and *Squaliolus* in the family Dalatiidae, and separate the Squalidae from the Dalatiidae by the presence of fin spines on both dorsals of the former family. As noted by Hubbs & McHugh (1951), loss of fin spines has probably occurred more than once among squaloids, and grouping squaloids by presence or absence of spines produces heterogeneous, polyphyletic groups. Preliminary work on squaloid morphology led me to group the squaloids other than *Echinorhinus* in a single family, Squalidae, with five subfamilies (Compagno, 1973c): Etmopterinae for Aculeola, Centroscyllium and Etmopterus; Squalinae for Centrophorus, Cirrhigaleus and Squalus; Deaniinae for Deania; Oxynotinae for Oxynotus; Somniosinae for Centroscymnus, possibly Enchiridiodon (later synonymized with Centrophorus by Bass, d'Aubrey & Kistnasamy (1976), Scymnodon and Somniosus; and Dalatiinae for Dalatias, Euprotomicroides, Euprotomicrus, possibly Heteroscymnoides, Isistius, Scymnodalatias, and Squaliolus. Further work indicates that Deania is closely related to Centrophorus and should be included in the Squalinae; Oxynotus is close to the genera placed in Somniosinae and should share a common group with them; that Scymnodalatias should be removed from the Dalatiinae and placed in the common group for Somniosinae and Oxynotinae; and that the Dalatiinae as restricted to Dalatias, Euprotomicroides, Euprotomicrus, Heteroscymnoides, Isistius and Squaliolus forms a compact if morphologically varied group of highly derived sharks. Pending completion and publication of my work on squaloid morphology I prefer to include the squaloid genera other than Echinorhinus and Oxynotus in a single family, Squalidae, without subdivision, and retain the family Oxynotidae for Oxynotus following common current practice (Bigelow & Schroeder, 1957, Bass, d'Aubrey & Kistnasamy, 1976).

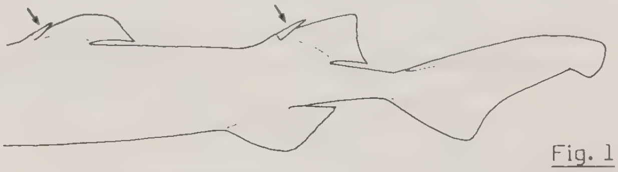


Fig. 1

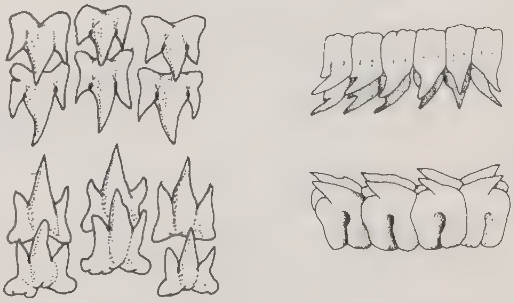
Key to Genera :

1a. Fin spines present on both dorsal fins (Fig. 1)

2a. Teeth of both jaws not expanded, compressed and bladelike, with narrow cusps (Fig. 2a); adjacent rows of teeth not imbricated

3a. Cusplets absent from most teeth in both jaws, when present very small (Fig. 3a). Fin spines very short (Fig. 3b) .... **Aculeola**

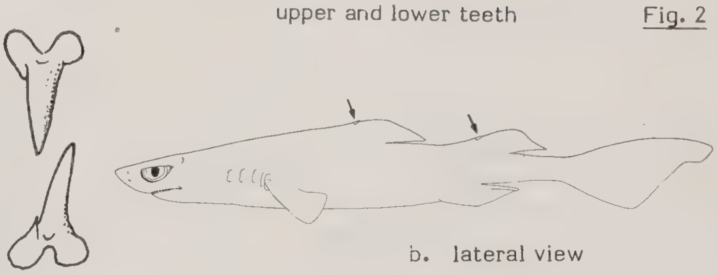
3b. Cusplets present and prominent on most teeth (Fig. 4a). Fin spines, especially that of second dorsal fin, relatively long (Fig. 4b) .... **Centroscyllium**



upper and lower teeth Fig. 2

2b. Lower teeth, and sometimes uppers also, compressed and bladelike, with broad cusps (Fig. 2b); adjacent rows of lower teeth, and sometimes uppers, imbricated

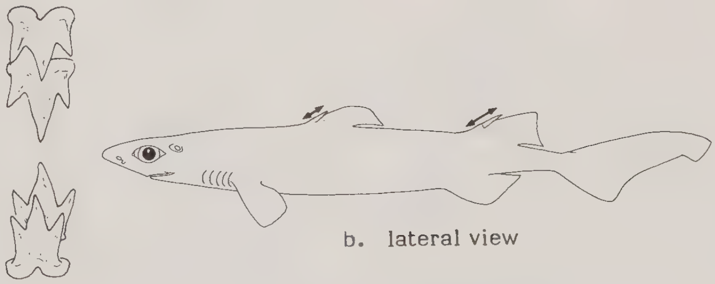
4a. Teeth nearly alike in upper and lower jaws, lowers not greatly enlarged; both with strongly oblique cusps (Fig. 5a). An upper precaudal pit (sometimes weak or absent) and a pair of lateral keels on the caudal peduncle (Fig. 5b). Dorsal fin spines not grooved



a. upper and lower tooth

b. lateral view

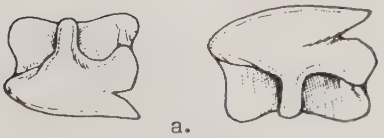
Aculeola Fig. 3



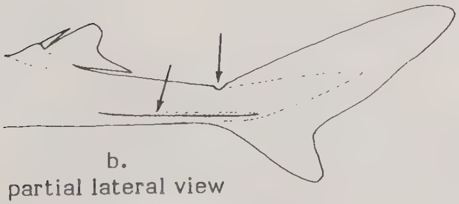
a. upper and lower teeth with cusplets

b. lateral view

Centroscyllium Fig. 4



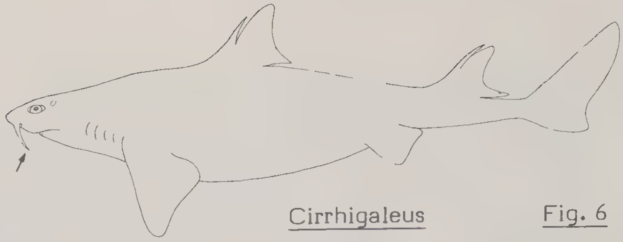
a. upper and lower teeth almost alike



b. partial lateral view

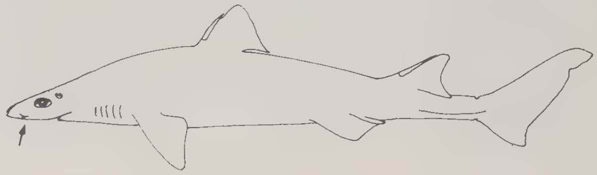
Squalus Fig. 5

5a. Anterior nasal flaps with elongated barbels, reaching mouth (Fig. 6) .. **Cirrhigaleus**



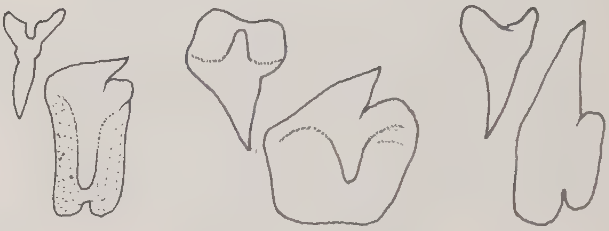
Cirrhigaleus Fig. 6

5b. Anterior nasal flaps without elongated barbels, not reaching mouth (Fig. 7) .... **Squalus**



Squalus Fig. 7

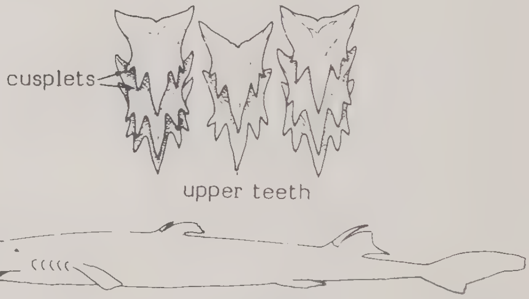
4b. Teeth more or less differentiated in upper and lower jaws, lowers much larger than uppers, uppers with erect to moderately oblique crests (Fig. 8). No precaudal pits or lateral keels on caudal peduncle. Dorsal fin spines grooved



teeth differentiated
lowers much larger than uppers

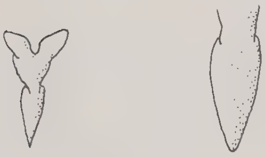
Fig. 8

6a. Upper teeth with cusplets in addition to a cusp (Fig. 9) .... **Etmopterus**



Etmopterus Fig. 9

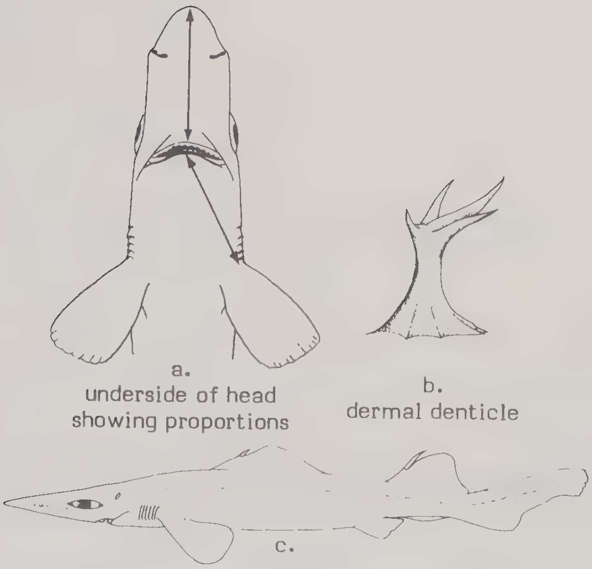
6b. Upper teeth without cusplets (Fig. 10)



upper teeth

Fig. 10

7a. Preoral snout length greater than distance from mouth to pectoral origins (Fig. 11a). Dermal denticles of back with tall, slender pedicels and pitchfork-shaped crowns (Fig. 11b); Fig. 11c .... **Deania**



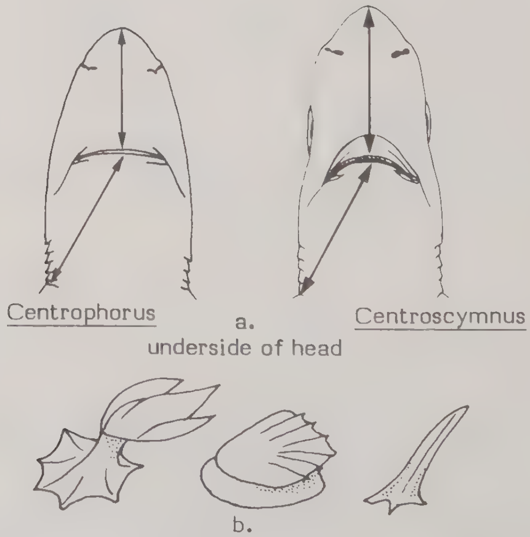
a. underside of head showing proportions

b. dermal denticle

c. Deania

Fig. 11

7b. Preoral snout length less than or rarely equal (in Centroscymnus crepidater) to distance from mouth to pectoral origins (Fig. 12a). Dermal denticles of back without pitchfork-shaped crowns (Fig. 12b)



a. underside of head

b. dermal denticles

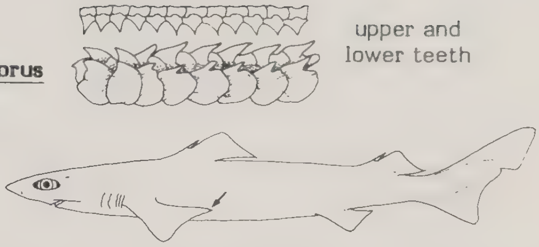
Fig. 12

8a. Upper teeth relatively broad, bladelike, lowers low and wide. Rear tips of pectoral fins short and angular to elongated and acutely pointed (Fig. 13) .... **Centrophorus**

8b. Upper teeth narrow, not bladelike, lowers high and wide. Rear tips of pectoral fins short and broadly rounded (Figs 14, 15)

9a. Lower teeth with relatively low, more or less oblique cusps (Fig. 14) .. **Centroscymnus**

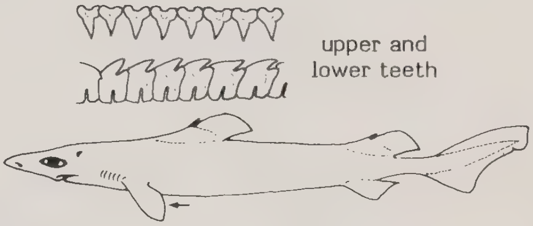
9b. Lower teeth with relatively high, more or less erect cusps (Fig. 15) .... **Scymnodon**


upper and lower teeth

Centrophorus Fig. 13

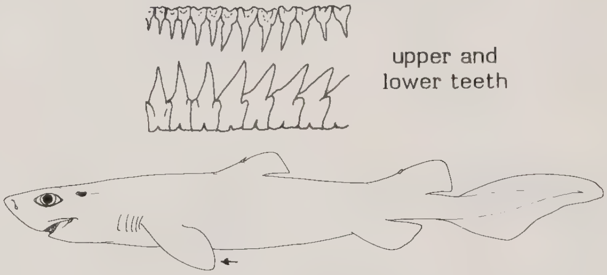
1b. Second dorsal fin, and usually first dorsal (except in Squaliolus) without a fin spine (Fig. 16)

10a. Gill openings increasing in width posteriorly, the fifth very wide. Pectoral fin inner margin and free rear tip greatly expanded and lobate. Second dorsal origin anterior to pelvic origins (Fig. 17). Cloaca greatly expanded as a luminous gland, with yellow papillae within it ..... **Euprotomicroides**

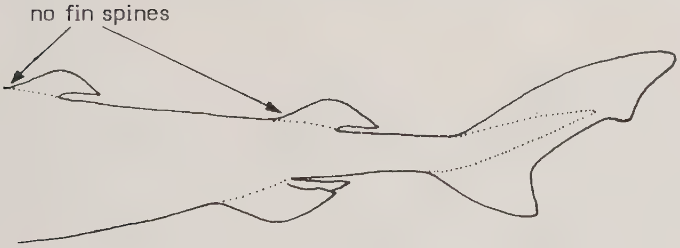

upper and lower teeth

Centroscymnus Fig. 14

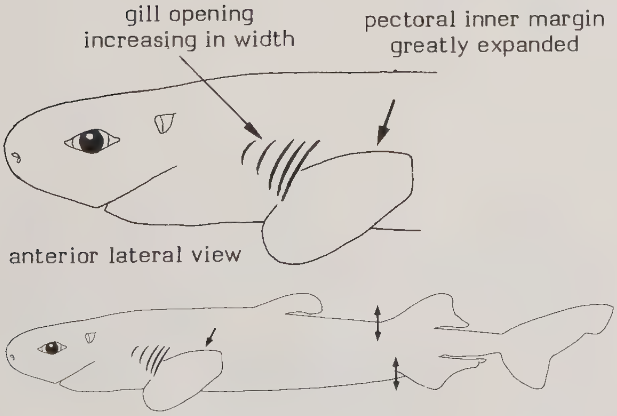
10b. Gill openings of uniform width. Pectoral fin inner margin and free rear tip not greatly expanded and lobate. Second dorsal origin posterior to pelvic origins (Fig. 18). Cloaca not expanded as a luminous gland, without papillae


upper and lower teeth

Scymnodon Fig. 15

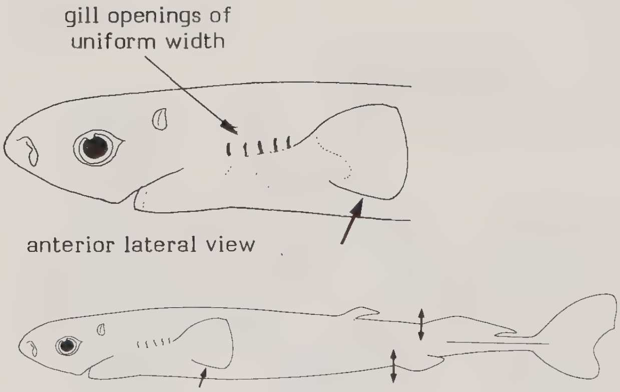

no fin spines

posterior lateral view Fig. 16


gill opening increasing in width
pectoral inner margin greatly expanded

anterior lateral view

Euprotomicroides Fig. 17


gill openings of uniform width

anterior lateral view

Fig. 18

11a. First dorsal insertion about over pelvic origins. Cusps of lower teeth covering the entire crown foot, without a convex accessory blade separated from the cusp by a notch (Fig. 19) .... **Isistius**

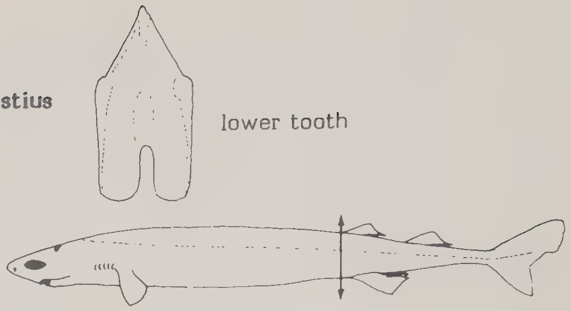
11b. First dorsal insertion well anterior to pelvic origins. Cusps of lower teeth covering part of the crown foot, with a convex distal blade separated from the cusp by a notch (Fig. 20)

12a. Second dorsal base at least twice as long as first dorsal base. Upper caudal lobe shortened, caudal paddle-shaped (Fig. 21a)

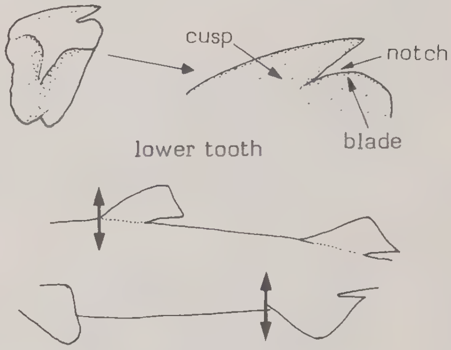
13a. First dorsal fin with a spine (sometimes concealed by skin); fin closer to pectoral bases than to pelvic bases. Second dorsal base about twice as long as first dorsal base. Snout more elongated and pointed, snout length about half length of head (Fig. 22) .... **Squaliolus**

13b. First dorsal fin spineless; fin closer to pelvic bases than to pectoral bases. Second dorsal base about four times as long as first dorsal base. Snout shorter and more bluntly rounded, snout length about 2/5 of head length (Fig. 23) .... **Euprotomicrus**

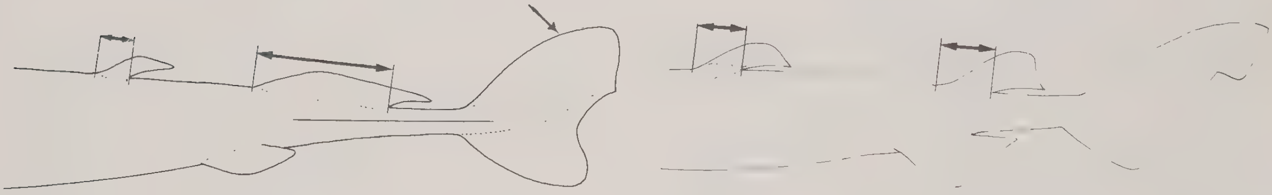
12b. Second dorsal base as long as first dorsal base or shorter. Upper lobe not shortened, caudal fin not paddle-shaped (Fig. 21b)



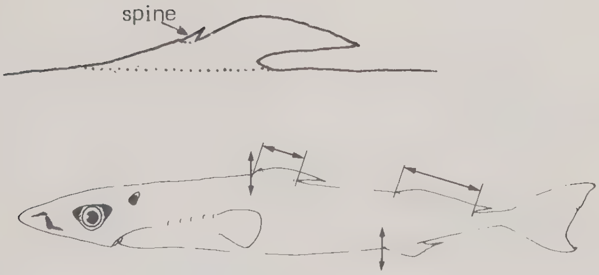
Isistius Fig. 19



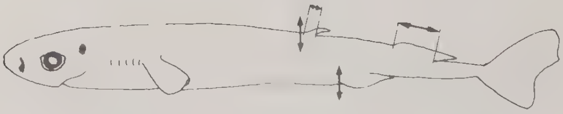
partial lateral view Fig. 20



partial lateral view, posterior end Fig. 21



Squaliolus Fig. 22



Euprotomicrus Fig. 23

14a. Preoral snout very short, less than 1/3 of head length. Lips thick and pleated (Fig. 24a). Lower teeth with strongly serrated edges (Fig. 24b). Caudal fin with weak ventral lobe (Fig. 24c) .... **Dalatias**

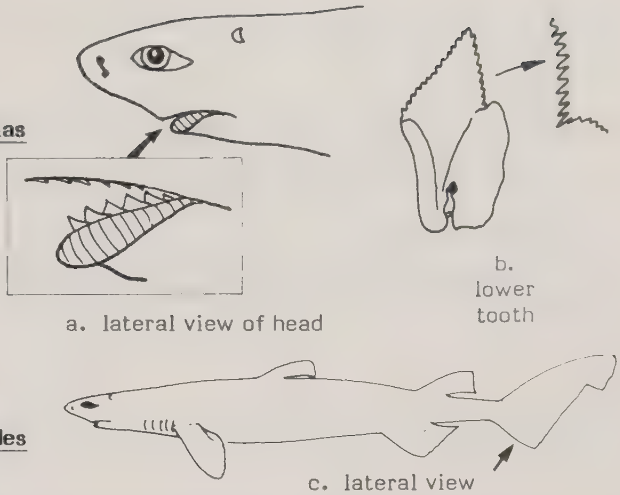
14b. Preoral snout longer, more than 1/3 of head length. Lips thin and not pleated (Fig. 25a). Lower teeth either with smooth or weakly serrated (some Somniosus spp.) edges (Fig. 25b). Caudal fin with a strong ventral lobe (Fig. 26)

15a. Preoral snout as long as distance from mouth to 5th gill openings or longer. First dorsal insertion over pectoral bases (Fig. 26) .... **Heteroscymnoides**

15b. Preoral snout shorter than distance from mouth to 5th gill openings. First dorsal insertion clearly behind pectoral bases (Figs 27, 28)

16a. Lower teeth with high, erect cusps. Ventral caudal margin half as long as dorsal caudal margin. Eyes horizontally elongated (Fig. 27) .... **Scymnodalatias**

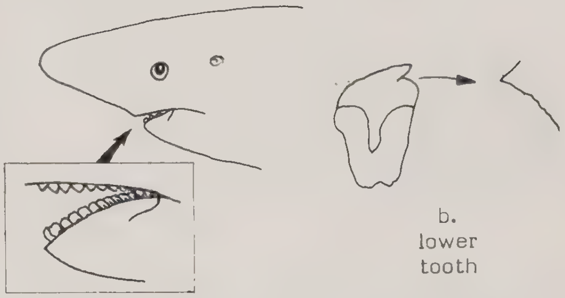
16b. Lower teeth with low, oblique cusps. Ventral caudal margin about 2/3 as long as dorsal caudal margin. Eyes nearly circular (Fig. 28) .... **Somniosus**


a. lateral view of head

b. lower tooth

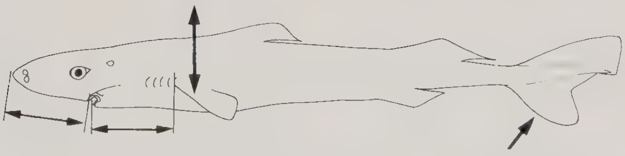
c. lateral view

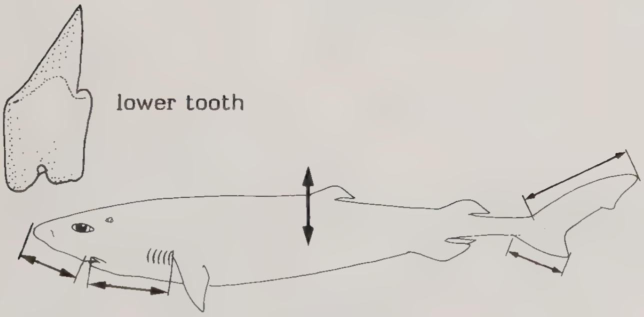
Dalatias Fig. 24


b. lower tooth

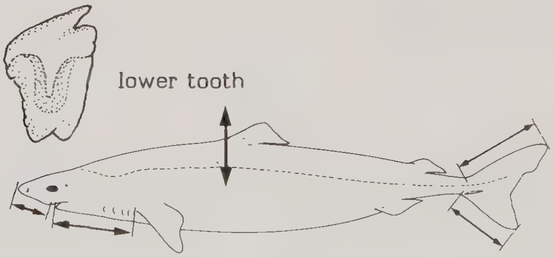
b. lateral view of head

Fig. 25


Heteroscymnoides Fig. 26



Scymnodalatias Fig. 27



Somniosus Fig. 28

Aculeola De Buen, 1959

SQUAL Acul

Genus : *Aculeola* De Buen, 1959a, *Bol.Mus.Nac.Hist.Nat.Santiago, Chile*, 27(3):180.

Type Species : *Aculeola nigra* De Buen, 1959, by original designation.

Synonymy : None.

Remarks : This monotypic genus is close to *Centroscyllium* but is clearly distinct, in anatomical characters (including jaw, cranial, and vertebral characters) as well as in external morphology.

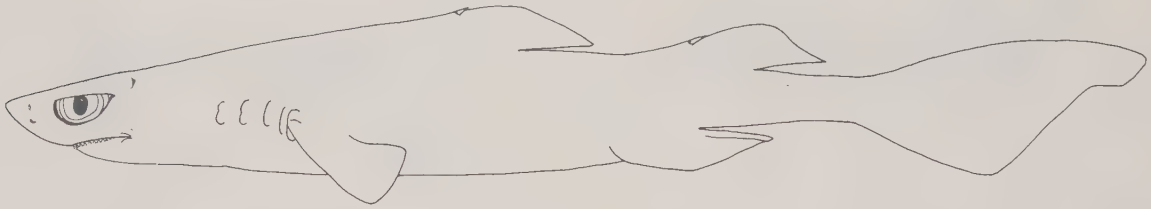
Aculeola nigra De Buen, 1959

SQUAL Acul 1

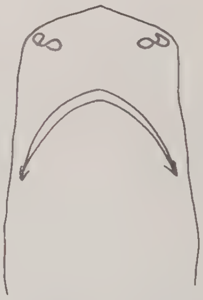
Aculeola nigra De Buen, 1959a, *Bol.Mus.Nac.Hist.Nat.Santiago, Chile*, 27(3):180. Holotype : Estacion de Biologia Marina de Montemar, Chile, No. EBMCh 10.191, apparently lost, 488 mm female. Type Locality: Off Concon, Chile, 110 m depth.

Synonymy : None.

FAO Names : En - Hooktooth dogfish; Fr - Squale noir; Sp - Tollo negro de cachos.



Diagnostic Features : Head with very short anterior nasal flaps; flaps not expanded as barbels; snout short, flattened and truncated, length much less than distance from mouth to pectoral origins and about 1/4 length of head; gill openings moderately large, increasing in width posteriorly; lips thin, not pleated or suctorial; teeth alike in both jaws, not bladelike, with a narrow, hooked, slender erect cusp, usually no cusplets, and no blades; about 60 rows of teeth in either jaw. Small grooved finspines present on both dorsal fins; first dorsal origin over pectoral inner margins, insertion well in front of pelvic origins and about midway between pectoral and pelvic bases; second dorsal origin about opposite or slightly behind pelvic origins, second dorsal slightly larger than first, with second dorsal base less than twice length of first dorsal base; pectoral fins with rounded free rear tips and short inner margins, not greatly expanded and narrowly pointed or broadly lobate; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe not differentiated, subterminal notch present and weak. Caudal peduncle without lateral keels, or precaudal pits. Dermal denticles with erect, narrow, conical ridged cusps and stellate bases. Cloaca without a luminous gland. Colour: blackish.



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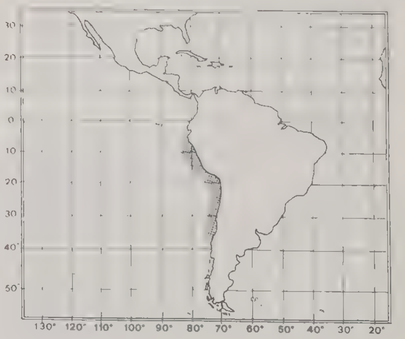
Geographical Distribution : Eastern Pacific: Peru to central Chile.



Habitat and Biology : A little-known, benthic and epibenthic shark of the Pacific south American continental shelf and upper slope, at depths of 110 to 560 mm. Ovoviviparous, number of young at least 3. Feeding habits unknown but probably small fishes and invertebrates. A relatively common species in its limited range.

Size : Maximum total length about 60 cm, size at birth probably about 13 or 14 cm (size of full-term fetuses), females mature between 52 and 54 cm and reach 60 cm, males mature at 42 to 46 cm.

Interest to Fisheries : None.

Centrophorus Müller & Henle, 1837

SQUAL Centr

Genus : *Centrophorus* Müller & Henle, 1837, *Ber.K.Preuss.Akad.Wiss.Berl.*, 2:115.

Type Species : *Squalus granulosus* Bloch & Schneider, 1801, by monotypy.

Synonymy : Genus *Lepidorhinus* Bonaparte, 1838; Genus *Entoxychirus* Gill, 1862; Genus *Entoxychyrus* Dumeril, 1865 (error ?); Genus *Machephilus* Johnson, 1867; Genus *Atractophorus* Gilchrist, 1922; Genus *Actractophorus* Gilchrist, 1922 (error ?); Subgenus *Gaboa* Whitley, 1940 (Genus *Centrophorus*); Subgenus *Somnispinax* Whitley, 1940 (Genus *Centrophorus*); Subgenus *Somnisphinax* Neave, 1950 (error for *Somnispinax*); Genus *Enchiridiodon* Smith, 1967.

Nomen Nudum : *Centrophorus squaloideus* Engelhardt, 1913.

Field Marks : Grey or grey-brown, huge green eyes, moderate-sized snout, spines on both dorsals, broad, bladelike upper and lower teeth without cusplets, lower teeth much larger than uppers, pectoral free rear tips angular to attenuated, caudal with strong subterminal notch.

Diagnostic Features : Head with short, anterior nasal flaps; flaps not expanded as barbels; snout flattened, broadly parabolic to slightly pointed, length less than distance from mouth to pectoral origins and half length of head or less; gill openings moderately broad, about equally wide or increasing slightly in width posteriorly; lips thin, not pleated or suctorial; teeth differing in upper and lower jaws, compressed, bladelike and interlocking in both jaws but much larger in the lower jaw; teeth of both jaws with a single cusp and variably developed distal blade but no cusplets, cusps of upper teeth erect to oblique, lower cusps oblique, crowns of teeth in both jaws rather broad and low, edges often serrated; tooth rows 31 to 42/27 to 35. Rather large, grooved, strong finspines present on both dorsal fins; first dorsal origin over pectoral insertions or inner margins, insertion well in front of pelvic origins and about equidistant between pectoral and pelvic bases or slightly closer to the pectoral bases; second dorsal origin varying from over last third of pelvic bases to slightly posterior to pelvic free rear tips; second dorsal smaller than first, its base about half to 3/4 length of first dorsal base; pectoral fins with free rear tips varying from squared-off and angular to elongated and acutely pointed, not broadly lobate; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe poorly differentiated to short and well-developed, subterminal notch present and strong. No precaudal pits or lateral keels on caudal peduncle. Dermal denticles with low, flat ridged crowns, varying from leaf-shaped and pediculate, with posterior cusps, to cuspless, block-shaped, and without pedicels. Cloaca without a luminous gland. Colour: light to dark grey or grey-brown above, often lighter below.

Remarks : The arrangement of this genus follows the revisions of Bigelow & Schroeder (1957), Garrick (1959), Cadenat (1959a,b), and Bass, d'Aubrey & Kistnasamy (1976), pending further work by S. Springer (in prep.). I follow Bigelow & Schroeder (1957), Cadenat (1959) and Bass, d'Aubrey & Kistnasamy (1976) in synonymizing *Atractophorus* (a genus proposed and used for juvenile *Centrophorus* specimens with barbs on their finspines which apparently are lost in adults) with *Centrophorus*, Bass, d'Aubrey & Kistnasamy (1976) in synonymizing *Enchiridiodon* with *Centrophorus*, and various writers in including *Lepidorhinus* in *Centrophorus*.

The current key and arrangement of species is highly tentative and probably will require considerable revision when new information is published. Particularly troublesome are the species of *Centrophorus* with sessile, block-like denticles, which vary considerably in denticle characters with growth. An alternative arrangement of some of these species is provided by Cadenat & Blache (1981), who list *granulosus*, *lusitanicus*, and *uyato* as 'formes' of *Centrophorus*, in recognition of the taxonomic difficulties provided especially by juveniles of the species. They provide a key to eastern Atlantic *Centrophorus* which accesses *C. granulosus* at three different places and *C. uyato* at two places to separate large adults, small adults and subadults, and juveniles of these species from each other and from other species.

Key to Species :

1a. Lateral trunk denticles with leaflike flattened crowns on elevated narrow to broad pedicels extending above the denticle bases, and with medial and lateral cusps on their posterior ends

  2a. Free rear tips of pectoral fins broadly angular and not reaching past first dorsal spine origin. Denticles of adults with multiple lateral cusps .... ***C. squamosus***

  2b. Free rear tips expanded into narrow angular lobes that reach past first dorsal spine origin. Denticles of adults with a pair of lateral cusps .... ***C. acus***

1b. Lateral trunk denticles with flat sessile atop the denticle bases, without separate pedicels and with or without a posterior medial cusp

3a. Second dorsal fin very small, half height of first dorsal or less, with spine origin usually well posterior to rear tips. Inner margins of pectoral fin longer than distance from second dorsal spine origin to upper caudal origin .... C. moluccensis

3b. Second dorsal fin larger, 3/4 of first dorsal height or more, with spine origin usually over pelvic inner margins. Inner margins of pectoral about as long or shorter than distance from second dorsal spine origin to upper caudal origin.

4a. Denticles of adults without cusps, crowns broadly rounded posteriorly

5a. Distance from first dorsal insertion to origin of second dorsal spine about as long as tip of snout to pectoral insertions .... C. granulosus

5b. Distance from first dorsal insertion to origin of second dorsal spine about as long as tip of snout to pectoral origins .... C. tesselatus

4b. Denticles of adults with medial cusps, crowns angular and thornlike posteriorly

6a. Snout rather short and broad, preoral length less than mouth width. Free rear tips of pectoral fins slightly elongated, not extending behind first dorsal spines. Lateral trunk denticles of adults narrow and teardrop-shaped. Postventral margin of caudal fin virtually straight in adults. A large species reaching over 1.5 m .... C. niaukang

6b. Snout rather long and narrow, preoral length greater than mouth width. Free rear tips of pectoral fins greatly elongated, extending well behind first dorsal spine. Lateral trunk denticles of adults broad and rhomboidal. Postventral margin of caudal fin notched in adults. Maximum size usually below 1 m .... C. uyato
C. harrisoni

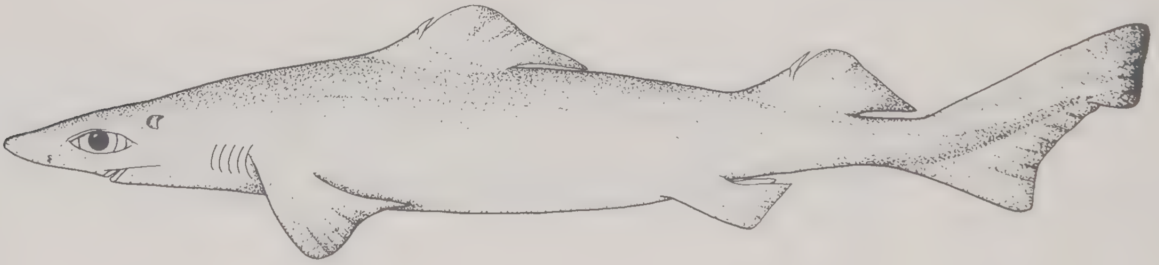
Centrophorus acus Garman, 1906

SQUAL Centr 5

Centrophorus acus Garman, 1906, Bull.Mus.Comp.Zool.Harvard, 46(11):204. Holotype : Museum of Comparative Zoology, Harvard, MCZ 1049. Type Locality : Japan.

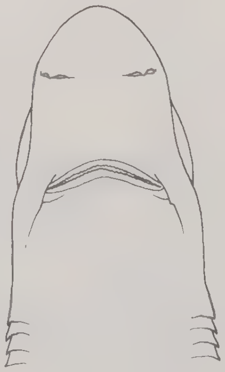
Synonymy : Centrophorus steindachneri Pietschmann, 1907; ?Centrophorus drygalskii Engelhardt, 1912.

FAO Names : En - Needle dogfish; Fr - Squale-chagrin aiguille; Sp - Quelvacho agujón.



Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long snout, leaf-shaped tricuspidate, semi-imbricated lateral denticles, and rear tips of pectoral fins narrowly angular and strongly extended.

Diagnostic Features : Snout moderately long, narrowly parabolic, preoral snout somewhat greater than mouth width but shorter than distance from mouth to pectoral origins; upper anterolateral teeth with erect to semioblique cusps. First dorsal fin relatively low and long; second dorsal moderately large, as high as first, with base about 3/4 length of first dorsal base, and spine origin over inner margins of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine about as



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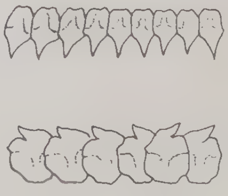
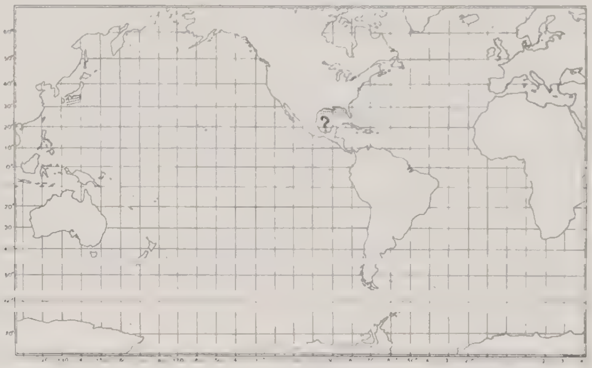


upper and lower teeth

long as tip of snout to pectoral midbases in adults; free rear tips of pectoral fins formed into a narrow, angular but only moderately elongated lobe that reaches the level of first dorsal spine, inner margins slightly shorter than distance from second dorsal spine to caudal origin. Caudal fin with shallowly concave or weakly notched postventral margin in adults. Lateral trunk denticles partly overlapping each other, with thick pedicels elevating flat, leaflike crowns, a strong main cusp and a pair of lateral cusps on their posterior edges in adults.



Geographical Distribution : Western North Pacific: Japan (southeastern Honshu). Western North Atlantic: Gulf of Mexico.

Habitat and Biology : A little-known deepwater dogfish of the western Pacific and western North Atlantic, probably found below 200 m depth.

Size : Mature males to at least 81 cm (holotype).

Interest to Fisheries : None?

Literature : Garman (1913); Bigelow & Schroeder (1957); Compagno & Vergara (1978); S. Springer (pers. comm.).

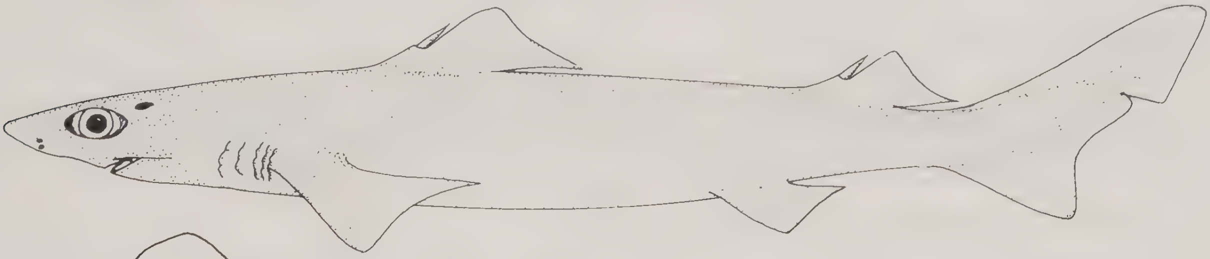
Centrophorus granulosus (Bloch & Schneider, 1801)

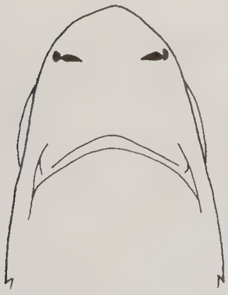
SQUAL Centr 1

Squalus granulosus Bloch & Schneider, 1801, *Syst.Ichthyol.*:135. Holotype : Apparently lost. Type Locality : None given in original account.

Synonymy : ? *Centrophorus bragancae* Regan, 1906; ? *Centrophorus atromarginatus* Garman, 1913; ? *Centrophorus machenquensis* Maul, 1955.

FAO Names : En - Gulper shark; Fr - Squale-chagrin commun; Sp - Quelvacho.





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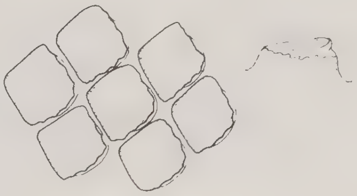
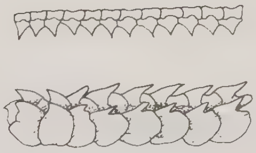


dermal denticles

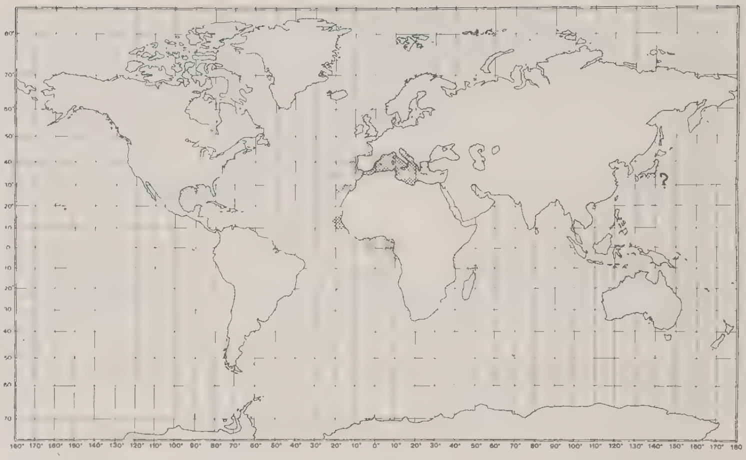


upper and lower teeth

Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long and broad snout, fairly short first dorsal fin and high second dorsal, blocklike, very broad, sessile-crowned, wide-spaced, acuspidate lateral denticles, and rear tips of pectoral fins narrowly angular and strongly extended.

Diagnostic Features : Snout moderately long, broadly parabolic, preoral snout subequal or somewhat greater than mouth width but shorter than distance from mouth to pectoral origins; upper anterolateral teeth with erect to semioblique cusps. First dorsal fin moderately high and short, second dorsal moderately large, nearly as high as first, with base about 3/4 length of first dorsal base, and spine origin over inner margins of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine about as long as tip of snout to pectoral insertions in adults and subadults; free rear tips of pectoral fins formed into narrow, angular and elongated lobes that reach well beyond the level of first dorsal spine, inner margins longer than distance from second dorsal spine to caudal origin; caudal fin with a shallowly notched posterior margin in adults and subadults. Lateral trunk denticles not overlapping each other, blocklike, with crowns sessile on bases and without pedicels, crowns broad and transversely rhomboidal in adults, without cusps on their posterior edges.

Geographical Distribution : Western North Atlantic: Northern Gulf of Mexico. Eastern Atlantic: France, Portugal, Madeira to Mediterranean, Canaries, Senegal, Ivory Coast, Nigeria, Cameroon to Zaire. Western Indian Ocean: Aldabra Island. Western Pacific: Japan (southeastern Honshu).



Habitat and Biology : A large fairly common deepwater dogfish of the outer continental shelves and upper slopes, usually on or near the bottom at depths from 100 to 1200 m, but commonest below 200 m. Ovoviviparous. Eats hake, epigonids and lanternfish.

Size : Maximum total length at least 150 cm, young are born from 30 to 42 cm or more.

Interest to Fisheries : Primarily fished in the eastern Atlantic with bottom trawls, but also caught on hook-and-line and with pelagic trawls. Smoked and dried salted for human consumption; also processed for fishmeal and liver oil. Potentially valuable for its large liver, with high squalene content in the liver oil. The Japanese representative of the species is fished for liver oil.

Literature : Bigelow & Schroeder (1957), Cadenat (1957); Compagno (1981); Cadenat & Blache (1981).

Remarks : The Japanese *C. atromarginatus* Garman, 1913 is often recognized as a valid species, but I tentatively include it in *C. granulosus* following Bigelow & Schroeder (1957), who compared the holotype of *C. atromarginatus* with Atlantic specimens and accounts of *C. granulosus* and could find no specific differences except possibly longer gill openings in the Atlantic material. I do agree with these writers that the separation of these species "...remains an open question" (Bigelow & Schroeder, 1957). The validity of *C. machequensis* and *C. braganzae* are uncertain also; these species are listed under *C. granulosus* as a present expedient only.

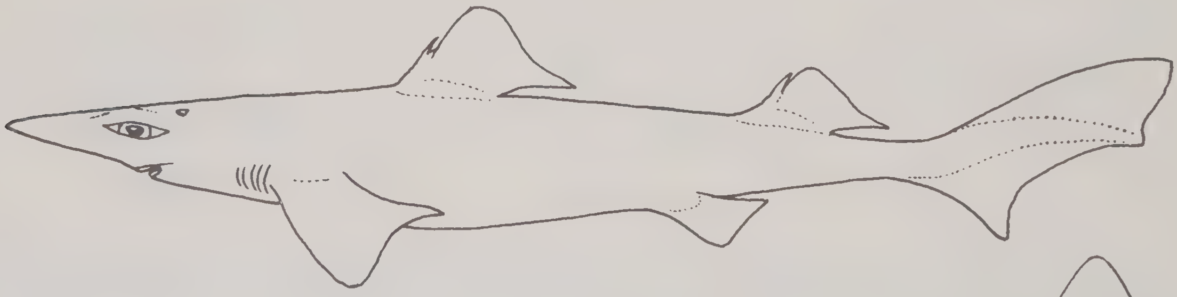
Centrophorus harrissoni McCulloch, 1915

SQUAL Centr 6

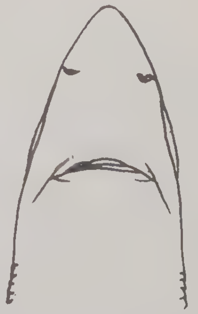
Centrophorus harrissoni McCulloch, 1915, *Zool.Result.Fish.Exp.Endeavour*, Commonw.Australia, Dept.Trade Cust., 3:99, pl. 14, fig. 1-4. Holotype : ? number, 760 mm female. Type Locality : Near Cabo Island, Victoria, Australia.

Synonymy : ? *Centrophorus armatus barbatus* Teng, 1962.

FAO Names : En - Dumb gulper shark; Fr - Squale-chagrin bilimélé; Sp - Quelvacho galludo.



Diagnostic Features : Very similar to *C. uyato* and possibly not distinct; said to differ in its partially serrated lower teeth, but serrations on the lower teeth are a variable feature in *Centrophorus*.



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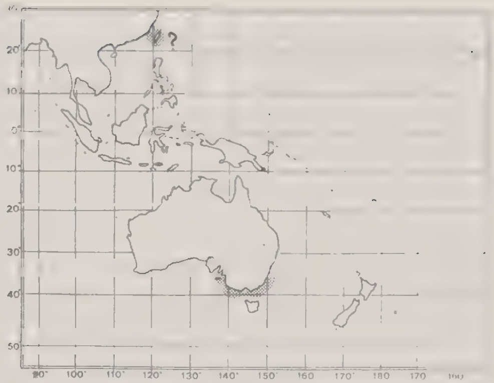


Geographical Distribution : Western Pacific: ? Taiwan Island, Australia.

Habitat and Biology : A little-known deepwater dogfish of the continental and insular slopes at 250 to 384 m.

Size : Maximum reported 80 cm.

Interest to Fisheries : None ?

Literature : Whitley (1940); Fowler (1941); Bigelow & Schroeder (1957); Teng (1962).

Remarks : C. harrissoni is very close to C. uyato and may be a junior synonym of that species. C. armatus barbatus Teng, 1962, is apparently not conspecific with Atractophorus armatus Gilchrist, 1922 (= C. moluccensis), but may instead be based on a juvenile (with barbed dorsal spines) of C. harrissoni or C. uyato. C. harrissoni itself is very close to C. uyato, and may be a junior synonym of that species.

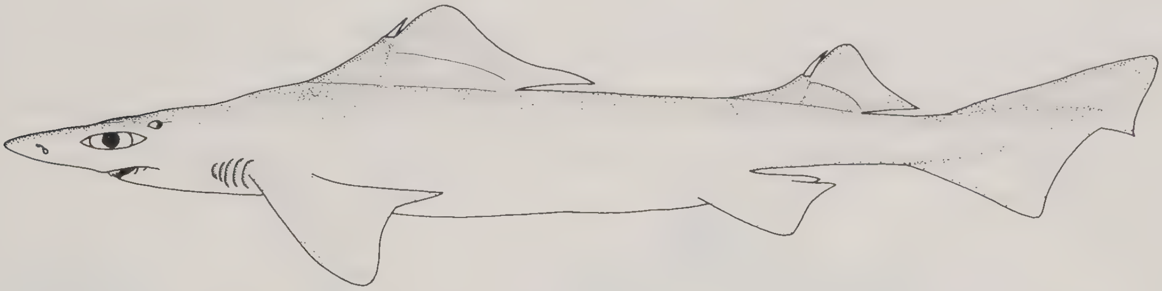
Centrophorus lusitanicus Bocage & Capello, 1864

SQUAL Centr 2

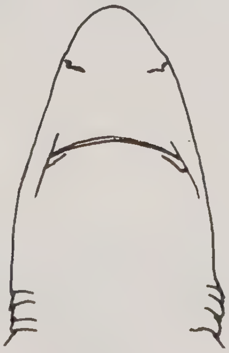
Centrophorus lusitanicus Bocage & Capello, 1864, Proc.Zool.Soc.Lond., 24:260, fig. 1. Holotype : A possible syntype in British Museum (Natural History), BMNH 1867.7.23.2, 75 cm immature male; other type material probably lost. Type Locality : Portugal, Atlantic Ocean.

Synonymy : ? Centrophorus ferrugineus Chu et al., 1982.

FAO Names : En - Lowfin gulper shark; Fr - Squale-chagrin à longue dorsale; Sp - Quelvacho lusitánico.



Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long and broad snout, very long first dorsal fin and high second dorsal, blocklike, sessile-crowned, wide-spaced, cuspidate lateral denticles, and rear tips of pectoral fins narrowly angular and strongly extended.



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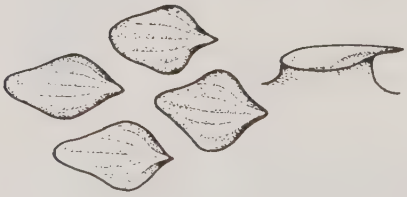
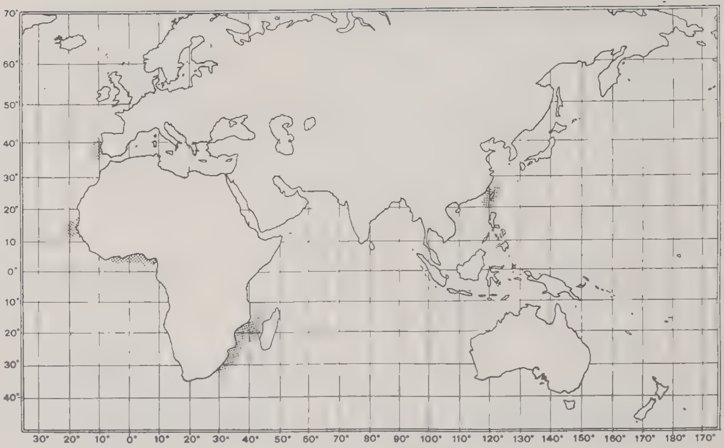


dermal denticles

Diagnostic Features : Snout moderately long, broadly parabolic, preoral snout equal or somewhat greater than mouth width but shorter than distance from mouth to pectoral origins; upper anterolateral teeth with semioblique or oblique cusps. First dorsal fin very low and long; second dorsal moderately large, nearly as high or slightly higher than first, with base about 1/2 to 3/5 length of first dorsal base, and spine origin over inner margins of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine about as long as tip of snout to pectoral midbases in adults and subadults; free rear tips of pectoral fins formed into narrow, angular and elongated lobes that reach well beyond the level of first dorsal spine, inner margins slightly shorter than distance from second dorsal spine to caudal origin; caudal fin with a shallowly concave to weakly notched posterior margin in adults and subadults. Lateral trunk denticles not overlapping each other, blocklike, with crowns sessile on bases and without pedicels, crowns elongated and longitudinally rhomboidal in adults, with a strong main cusp and no lateral cusps on their posterior edges in adults.



Geographical Distribution : Eastern North Atlantic: Portugal, Senegal, Ivory Coast to Nigeria. Western Indian Ocean: South Africa and Mozambique Channel. Western Pacific: Taiwan Island.

Habitat and Biology : A large deepwater dogfish of the outer continental shelves and upper slopes at depths between 300 to 1400 m. Ovoviviparous, number of young 1 to 6 per litter. Eats bony fishes, squid, small dogfish sharks, and lobsters.

Size : Adults reach at least 160 cm; adult males from 72 to 128 cm and females from 88 to 144 cm; size at birth about 36 cm.

Interest to Fisheries : Primarily utilized in the eastern Atlantic, and captured there in bottom trawls and with fixed bottom nets and line gear. Dried and salted for human consumption, and processed for fishmeal. Fished also off Taiwan Island, Province of China.

Literature : Bigelow & Schroeder (1957); Cadenat (1959a,b); Teng (1962); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981); Compagno (1981).

Remarks : The writer examined the above-mentioned syntype in the British Museum (Natural History). Centrophorus ferrugineus of Chu et al., (1982) is a recently described dogfish from the South China Sea that may be identical to the present species. C. lusitanicus itself has been described from Taiwan Island (Teng, 1962).

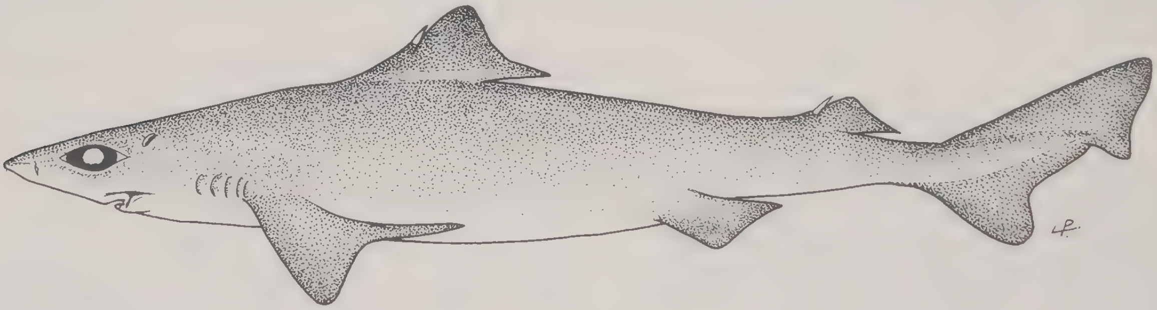
Centrophorus moluccensis Bleeker, 1860

SQUAL Centr 7

Centrophorus moluccensis Bleeker, 1860, Act.Soc.Sci.Indo-Neerl., 1860, 8:3. Holotype : Rijksmuseum van Natuurlijke Historie, RMNH 7415, 188 mm late fetus. Type Locality : Ambon, Indonesia.

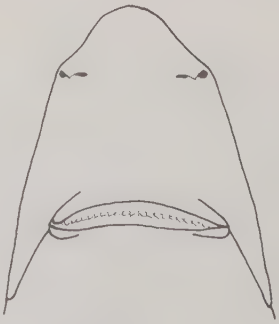
Synonymy : Centrophorus scalpratus McCulloch, 1915; Atractophorus armatus Gilchrist, 1922.

FAO Names : En - Smallfin gulper shark; Fr - Squale-chagrin cagaou; Sp - Quelvacho de aleta corta.



Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long snout, moderate-sized first dorsal fin and very small second dorsal, blocklike sessile-crowned, wide-spaced, cuspidate lateral denticles, and rear tips of pectoral fins narrowly angular and greatly elongated.

Diagnostic Features : Snout moderately long and parabolic, preoral snout greater than mouth to pectoral origins; upper anterolateral teeth with semierect or oblique cusps. First dorsal fin fairly high and short; second dorsal very small, half height of first dorsal or less, with base less than 1/2 to nearly 3/5 length of first dorsal base, and spine origin well behind rear tips of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine greater than distance from tip of snout to pectoral insertions in adults; free rear tips of pectoral fins formed into narrow, angular and greatly elongated lobes that reach well beyond the level of first dorsal spine, inner margins equal or longer than distance from second dorsal spine to caudal origin; caudal fin with a deeply notched



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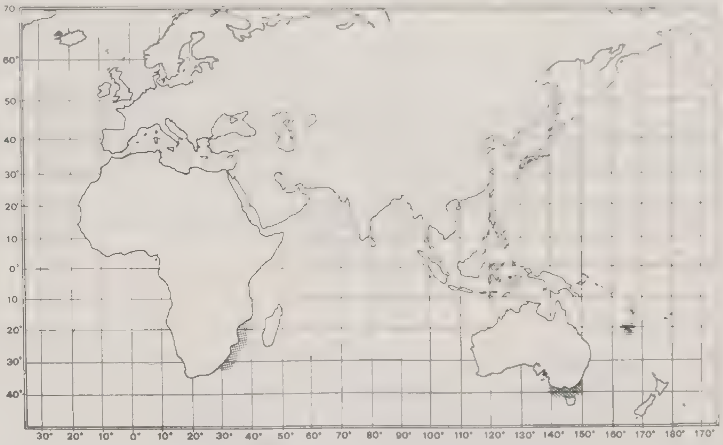
postventral margin in adults. Lateral trunk denticles not overlapping each other, blocklike, with crowns sessile on bases and no pedicels, crowns broad, squared or vertically rhomboidal in adults, with a strong main cusp and no lateral cusps on their posterior edges.

Geographical Distribution : Western Indian Ocean: South Africa, southern Mozambique. Western Pacific: Japan (Okinawa), Indonesia (Ambon), Australia (Victoria), New Hebrides, New Caledonia.

Habitat and Biology : A common deep-water dogfish of the outer continental shelves and upper slopes on or near the bottom at depths from 128 to 823 m. Ovoviviparous, number of young two per litter. Full term fetuses were found in summer off South Africa. Eats primarily bony fish, including lanternfish, bramids, carangids, worm-eels, bonito, hairtails, oilfishes, as well as other dogfish sharks, squid, octopi, shrimp, and even tunicates.



Size : Maximum about 98 cm; males maturing between 69 and 73 cm and reaching 86 cm; females maturing above 89 cm and reaching 98 cm; size at birth about 31 to 37 cm.

Interest to Fisheries : Presumably taken by bottom trawlers off South Africa and Australia. Potentially important for its abundance off the coasts of South Africa and southern Mozambique. Probably figures in the shark liveroil fishery off Okinawa.

Literature : Whitley (1940); Bass, d'Aubrey & Kistnasamy (1976).

Remarks : *Centrophorus moluccensis* Bleeker, 1860 was described from a fetal specimen from Ambon, Indonesia (RMNH 7415, holotype of the species), and has either been recognized as a valid species (Regan, 1908b; Garman, 1913) or a dubious species (Dumeril, 1865; Günther, 1870; Fowler, 1941; Bigelow & Schroeder, 1957) of *Centrophorus*. Günther (1870) noted that Bleeker sent a specimen of *C. moluccensis* to the British Museum (Natural History), which Günther, and later Regan (1908b) incorrectly regarded as the "type of *Centrophorus moluccensis* Bleeker" (Günther, 1870). I examined this specimen (BMNH 1867.11.28.201, a 220 mm late fetal female in good condition), and found it agrees with published accounts of *C. scalpratus* in its relatively narrow-based first dorsal fin, first dorsal origin well behind pectoral origins, very small second dorsal fin with its height about half the first dorsal height and its origin well behind the pelvic fins, and long, attenuated pectoral fin inner margins. Through the help of Drs M. Boeseman and M.J.P. van Oijen of the Rijksmuseum van Natuurlijke Historie, Leiden, I was provided information on two specimens of Bleeker's *C. moluccensis* catalogued under RMNH 7415, the 188 mm holotype and another, 208 mm specimen. The holotype is in poor condition, at present, but agrees with *C. scalpratus* in the positions of its first and second dorsal fins. The 208 mm fetus agrees with the BMNH fetus and published data on *C. scalpratus* in the above particulars. It is not known for certain if the three fetuses came from different mothers, except that the mention of only the 188 mm specimen in Bleeker's original description of *C. moluccensis* suggests that at least this specimen had different parentage than the two other fetuses. In any event, the three fetuses are apparently conspecific with each other; they are tentatively considered as conspecific with published material of *C. scalpratus*, and this species is ranked as a junior synonym of *C. moluccensis*.

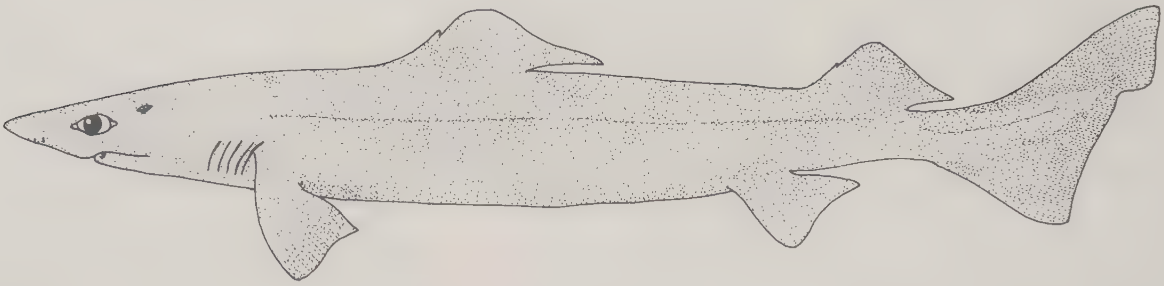
Centrophorus niaukang **Teng, 1959**

SQUAL Centr 8

Centrophorus niaukang Teng, 1959c, *Rep.Lab.Fish., Biol.Taiwan, Fish.Res.Inst.Keelung*, (9):1. Holotype : Taiwan Fisheries Research Institute, TFRI 3612, 1540 mm adult female. Type Locality : Northeast coast of Taiwan (Province of China), 24°48'N, 121°54'E, at about 250 m depth.

Synonymy : None.

FAO Names : En - Taiwan gulper shark; Fr - Squale-chagrin quelvacho; Sp - Quelvacho chino.



Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long and broad snout, long first dorsal fin and high second dorsal, blocklike, sessile-crowned, wide-spaced, teardrop-shaped, strongly cuspidate lateral denticles, and rear tips of pectoral fins broadly angular and slighthly extended.

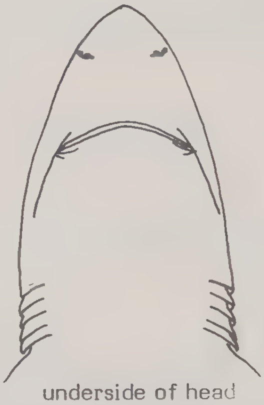
Diagnostic Features : Snout moderately long, broadly parabolic, preoral snout somewhat less than mouth width and considerably shorter than distance from mouth to pectoral origins; upper anterolateral teeth with erect to semioblique cusps. First dorsal fin fairly low and long; second dorsal moderately large, about as high as first, with base about 3/4 length of first dorsal base, and spine origin over inner margins of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine about as long as tip of snout to pectoral insertions in adults and subadults; free rear tips of pectoral fins formed into moderately broad, angular and slightly elongated lobes that fall in front of the level of first dorsal spine, inner margins considerably shorter than distance from second dorsal spine to caudal origin; caudal fin with a nearly straight posterior margin in adults and subadults. Lateral trunk denticles not overlapping each other, blocklike, with crowns sessile on bases and without pedicels, crowns longitudinally elongated and teardrop-shaped in adults, with a strong main cusp and no lateral cusps on their posterior edges.

Geographical Distribution : Only known from the type locality, off northeastern Taiwan Island.

Habitat and Biology : A little-known but common deepwater dogfish from off Taiwan Island, at about 250 m depth.

Size : The type specimen is an adult female, 154 cm long, suggesting that this species is one of the larger species of Centrophorus.

Interest to Fisheries : Regularly fished with line gear off Taiwan, Province of China, for its large liver with oil rich in squalene.



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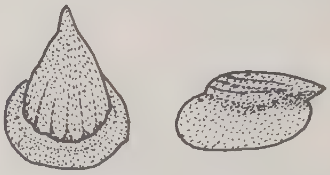
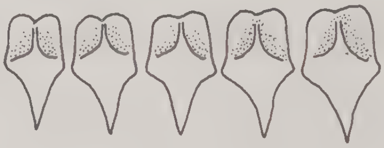
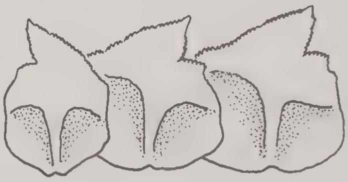
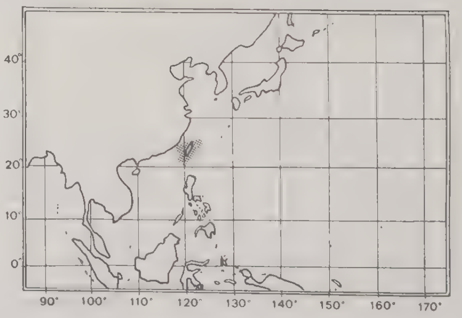


dermal denticles





teeth of
centre of jaw



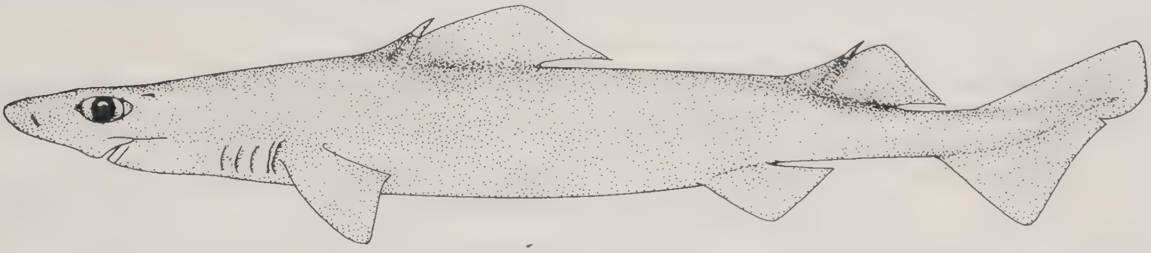
Centrophorus squamosus (Bonnaterre, 1788)

SQUAL Centr 3

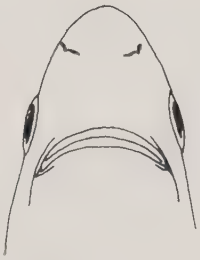
Squalus squamosus Bonnaterre, 1788, Tabl.Encyclop.Method.Trois Reg.Nat., Ichthyol., Paris:12. Holotype : Museum National d'Histoire Naturelle, Paris, MNHN-A7829 (head only). Type Locality : Not given.

Synonymy : Machephilus dumerili Johnson, 1867; Centrophorus foliaceus Günther, 1877; Centroscymnus fuscus Gilchrist & von Bonde, 1924; Centrophorus nilsoni Thompson, 1930; Enchiridiodon hendersoni J.L.B. Smith; ? Lepidorhinus kinbei Tanaka, (? date).

FAO Names : En - Leafscale gulper shark; Fr - Squale-chagrin de l'Atlantique; Sp - Quelvacho negro.



Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long snout, leaf-shaped multicuspidate, imbricated lateral denticles, and rear tips of pectoral fins broadly angular and not strongly extended.



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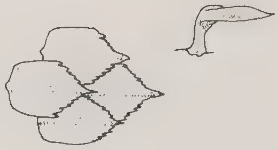
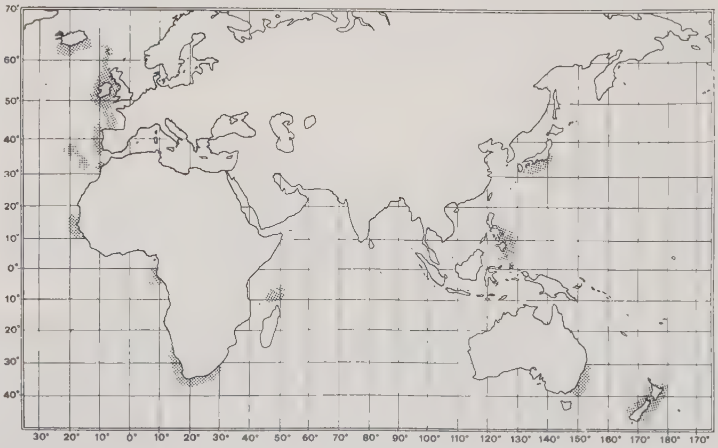


dermal denticles

Diagnostic Features : Snout moderately long, broadly parabolic, preoral snout almost equal to mouth width but shorter than distance from mouth to pectoral origins; upper anterolateral teeth with erect to semi-oblique cusps. First dorsal fin relatively low and long; second dorsal moderately large, as high or higher than first, with base about 2/3 length of first dorsal base, and spine origin about over rear tips or inner margins of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine about as long as tip of snout to pectoral midbases in adults; free rear tips of pectoral fins forming broad angles, not expanded into elongated lobes and not reaching the level of first dorsal spine, inner margins shorter than distance from second dorsal spine to caudal origin; caudal fin with a shallowly concave postventral margin in adults. Lateral trunk denticles overlapping one another, with slender pedicels elevating flat, leaflike crowns, a strong main cusp and 3 or more pairs of lateral cusps on their posterior edges in adults (lateral cusps increasing from a pair in young with denticle replacement with growth).

Geographical Distribution : Eastern Atlantic: Iceland and Atlantic Slope to Senegal, Faeroes, Madeira, Azores, Gabon to Zaire, Namibia, western Cape of Good Hope. Western Indian Ocean: South Africa, Aldabra Islands. Western Pacific: Japan, Philippines (Leyte, Mindanao), southeastern Australia, New Zealand.

Habitat and Biology : A large, deepwater dogfish of the continental slopes from 229 to 2359 m depth, but rare above 1000 m depth in the eastern Atlantic. Also found pelagically between the surface and 1250 m depth over water 3940 m deep. Ovoviviparous, with litters of 5 young.



Size : Maximum total length about 158 cm, males mature at about 103 cm, females at 137 to 158 cm.

Interest to Fisheries : In the eastern Atlantic, fished with bottom trawls, line gear and fixed bottom nets, and utilized dried salted for human consumption and for fishmeal. Probably fished elsewhere where it occurs, but details lacking.

Literature : Bigelow & Schroeder (1957); Garrick (1959); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981); Compagno (1981).

Remarks : I follow Bigelow & Schroeder (1957), Garrick (1959) and Bass, d'Aubrey & Kistnasamy (1976) in the synonymy of this species.

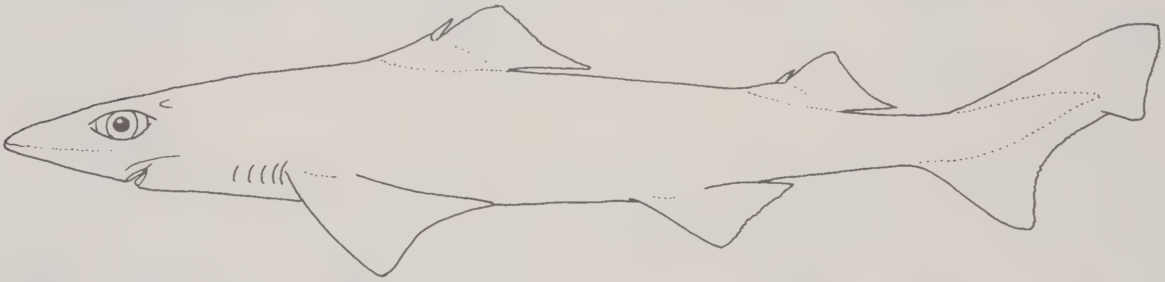
Centrophorus tessellatus Garman, 1906

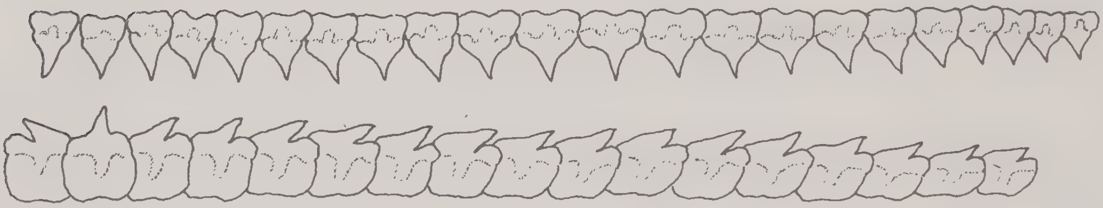
SQUAL Centr 9

Centrophorus tessellatus Garman, 1906, Bull.Mus.Comp.Zool.Harvard, 46(11):205. Holotype : Museum of Comparative Zoology, Harvard MCZ 1031, 887 mm adult male. Type Locality : Japan, southeastern Honshu, 35^{0}N, 30'E, 728 m.

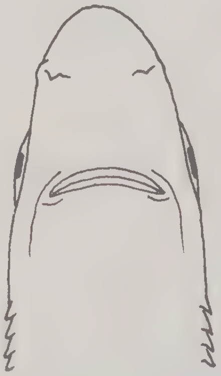
Synonymy : None.

FAO Names : En - Mosaic gulper shark; Fr - Squale-chagrin mosaïque; Sp - Quelvacho mosaico.





upper and lower left teeth



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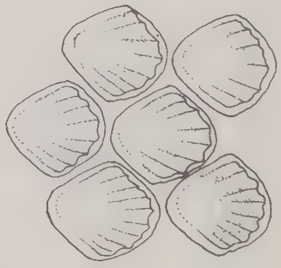


dermal denticles

Field Marks : No anal fin, two dorsal fins with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a moderately long and broad snout, fairly short first dorsal fin and high second dorsal, blocklike very, sessile-crowned, wide-spaced, acuspidate lateral denticles, and rear tips of pectoral fins narrowly angular and strongly extended.

Diagnostic Features : Snout moderately long, broadly parabolic, preoral snout somewhat greater than mouth width but shorter than distance from mouth to pectoral origins; upper anterolateral teeth with erect to semioblique cusps. First dorsal fin moderately high and short, second dorsal moderately large, nearly as high as first, with base about 3/4 length of first dorsal base, and spine origin over free rear tips of pelvic fins; distance from first dorsal insertion to origin of second dorsal spine slightly less than distance from tip of snout to pectoral origins in adults and subadults; free rear tips of pectoral fins formed into narrow, angular and elongated lobes that reach well beyond the level of first dorsal spine, inner margins shorter than distance from second dorsal spine to caudal origin; caudal fin with a shallowly notched posterior margin in adults and subadults. Lateral trunk denticles not over lapping each other, blocklike, with crowns sessile on bases and without pedicels, crowns broad and transversely rhomboidal in adults, without cusps on their posterior edges.

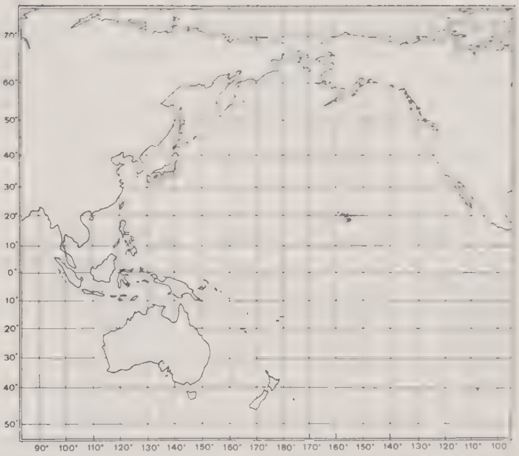
Geographical Distribution : Western North Pacific: Southeastern Honshu, Japan. Central Pacific: Hawaiian Islands.

Habitat and Biology : A little-known gulper shark of the insular slopes near or on the bottom at 260 to 728 m depth.

Size : Maximum total length 89 cm (holotype).

Interest to Fisheries : Apparently rare and of no importance to fisheries, unlike some other member of the genus Centrophorus.

Literature : Garman (1913); Bigelow & Schroeder (1957); Clarke (1972).



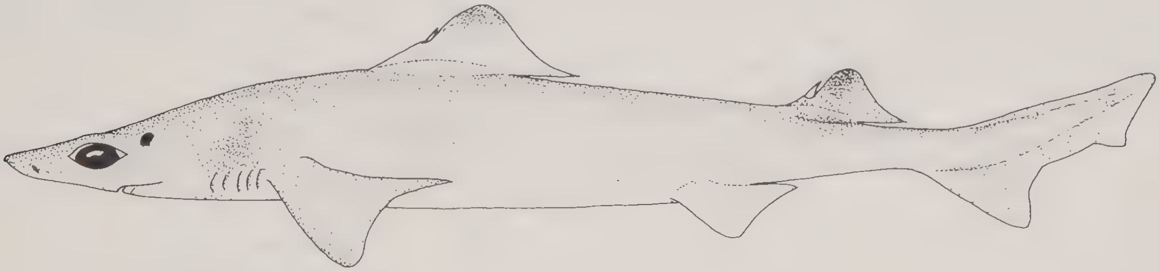
Centrophorus uyato (Rafinesque, 1810)

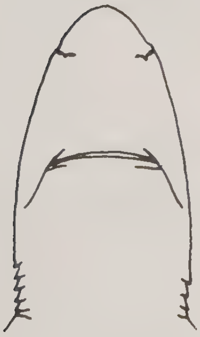
SQUAL Centr 4

Squalus uyato Rafinesque, 1810, Caratt.gen.sp.anim.piant.Sicilia, Palermo, Pt. 1:12, pl. 14, fig. 2. Holotype : Not known. Type Locality : Sicily, Mediterranean Sea.

Synonymy : ? Squalus infernus Blainville, 1825; ? Acanthias nigrescens Nardo, 1860; ? Centrophorus armatus barbatus Teng, 1962.

FAO Names : En - Little gulper shark; Fr - Petit squale-chagrin; Sp - Galludito.





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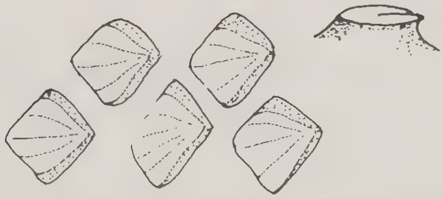
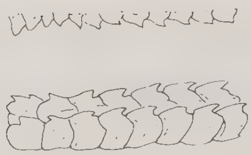


dermal denticles

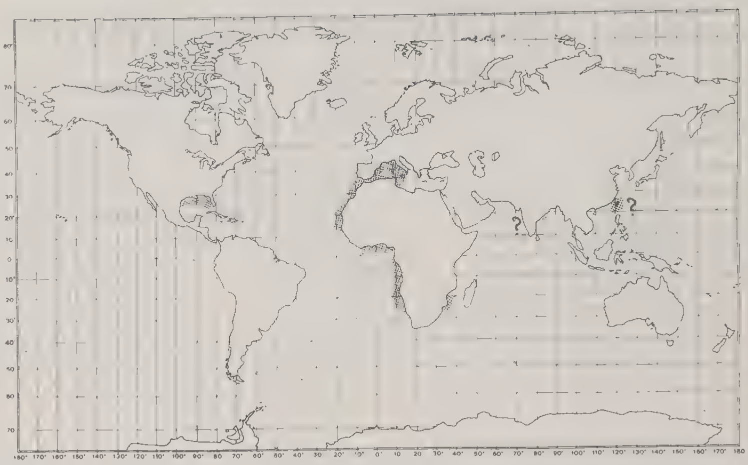


upper and
lower teeth

Field Marks : No anal fin, two dorsal fin with large spines, bladelike unicuspidate teeth in upper and lower jaws, with lowers much larger than uppers, a long and narrow snout, fairly short first dorsal fin and high second dorsal, blocklike, very broad, sessile-crowned, wide-spaced, cuspidate lateral denticles, and rear tips of pectoral fins narrowly angular and strongly extended.

Diagnostic Features : Snout rather long, narrowly parabolic, preoral snout greater than mouth width and about equal to distance from mouth to pectoral origins. Upper anterolateral teeth with mostly semioblique or oblique cusps. First dorsal fin moderately high and short, second dorsal moderately large, nearly as high as first, with base about 3/4 length of first dorsal base, and spine origin over rear tips or inner margins of pelvic fins; distance from first dorsal insertion to origin of second drosal spine about as long as tip of snout to pectoral insertions in adults and subadults; free rear tips of pectoral fins formed into narrow, angular and elongated lobes that reach well beyond the level of first dorsal spine, inner margins about equal to distance from second dorsal spine to caudal origin; caudal fin with a strongly notched posterior margin in adults and subadults. Lateral trunk denticles not overlapping each other, blocklike, with crowns sessile on bases and without pedicels, crowns broad and transversely rhomboidal in adults, with very short cusps on their posterior edges.

Geographical Distribution : Western North Atlantic: Gulf of Mexico. Eastern Atlantic: western Mediterranean and Gibraltar to Senegal, Ivory Coast to Nigeria, Cameroon to Angola, northern Namibia. Indian Ocean: southern Mozambique, ? India. ? Western North Pacific: Taiwan Island.



Habitat and Biology : A common deep-water dogfish of the outer continental shelves and upper slopes, on or near the bottom, in depths from 50 to 1400 m and commonest below 200 m. Ovoviviparous, number of young usually only one. Feeds on bony fishes and squid.

Size : Maximum total length about 100 cm, males mature between about 81 and 94 cm, mature females from 75 to 89 cm, size at birth between 40 and 50 cm.

Interest to Fisheries : Known fisheries primarily in the eastern Atlantic, where this species is taken with bottom trawls, line gear, fixed bottom nets and pelagic trawls. It is utilized dried salted for human consumption; probably also for fishmeal and liver oil. Its liver oil is potentially valuable for its high squalene content.

Literature : Bigelow & Schroeder (1957); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981); S. Springer (pers. comm.).

Remarks : *Centrophorus harrissoni* may not be distinct from this small, long-nosed species. *C. uyato* is difficult to distinguish from the larger *C. granulosus* when immature or subadult (see Cadenat & Blache, 1981 for a detailed account of this problem), but adults apparently can be separated by their considerably smaller size, longer and narrower snout, retention of a cusp on their blocklike lateral denticles, usually more oblique-cusped upper teeth, and often a darker mouth lining.

Centroscyllium Müller & Henle, 1841

SQUAL Centro

Genus : *Centroscyllium* Müller & Henle, 1841, *Syst.Beschr.Plagiost.Suppl.*:191.

Type Species : *Centroscyllium fabricii* Müller & Henle, 1841, by monotypy, equals *Spinax fabricii* Reinhardt, 1825

Synonymy : Genus *Paracentroscyllium* Alcock, 1889.

Field Marks : Greyish or blackish-brown, no anal fin, well-developed dorsal fin spines, short to moderately long snout, comblike teeth with cusps and cusplets in both jaws.

Diagnostic Features : Anterior nasal flaps short,not expanded as barbels; snout flattened, truncated-parabolic to slightly pointed, short to moderately long, length less than distance from mouth to pectoral origins and less than half length of head; gill opening small to moderately broad about equally wide or increasing very slightly in width posteriorly; lips thin, not pleated or suctorial; teeth alike in upper and lower jaws, with slender cusps and prominent cusplets not bladelike; tooth rows 45 to 68 in either jaw. Strong, grooved finspines present on both dorsal fins, the second dorsal spine strikingly larger than the first; first dorsal origin over or somewhat behind pectoral inner margins, insertion well in front of pelvic origins but varying from closer to the pectoral bases to closer to the pelvic bases; second dorsal origin varying from over first half of pelvic bases to about over pelvic free rear tips; second dorsal larger than first, its base less than twice length of first dorsal base; pectoral fins with short, broadly rounded free rear tips and inner margins, not broadly lobate or acute and attenuated; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe weakly differentiated, subterminal notch present and strong. Caudal peduncle without precaudal pits or lateral keels. Dermal denticles with slender, acute, erect, narrow ridged cusps and stellate bases. Cloaca without a luminous gland. Colour greyish to blackish brown above and below.

Remarks : Bigelow & Schroeder (1957) recognized five species of this poorly known genus, C. fabricii, C. granulatum, C. nigrum, C. ornatum, and C. ritteri, to which Abe (1966) added a sixth new species, C. kamoharai. Recently Nakaya (in Okamura et al., 1982) reported that there were two species of Centroscyllium from the Kyushu-Palau Ridge near Japan, which could not be placed in existing species. At least one of these species a slender, Etmopterus-like, long-nosed shark, is almost certainly new, and the other, a very heavy-bodied, short-nosed species, may very well be new also.

The following account of the genus and key to species is highly provisional:

Key to Species:

1a. Colour grey-brown above, with striking black markings on undersides of head, abdomen, and pectoral fins, and sides of tail .... **C. ritteri**

1b. Colour blackish or blackish-brown above and below, without black markings on underside of body or sides of tail

  2a. Rear tips of pectoral fins ending well anterior to origin of first dorsal spine. Distance between pectoral and pelvic bases much greater than head length

    3a. Caudal peduncle elongated, distance from second dorsal insertion to upper caudal origin somewhat longer than distance from eye to pectoral origins. A dwarf species, adult at less than 30 cm long .... **C. granulatum**

    3b. Caudal peduncle rather short, distance from second dorsal origin to upper caudal origin as long as distance from eye to third gill slits or less. Size larger, adult at over 40 cm long

      4a. Mouth long and more narrowly arched. Denticles close-set on body. A large species, adult at over 50 cm long .... **C. fabricii**

      4b. Mouth short and more broadly arched. Denticles few and wide-spaced, skin of body almost naked. A smaller species, adult between 40 and 50 cm .... **C. kamoharai**

  2b. Rear tips of pectoral fins ending about opposite origin of first dorsal spine or slightly in front of it. Distance between pectoral and pelvic bases about equal to head length or less

    5a. Fins with white tips. Mouth fairly short, less than a third as high as wide .... **C. nigrum**

    5b. Fins without white tips. Mouth fairly long, almost half as high as wide .... **C. ornatum**

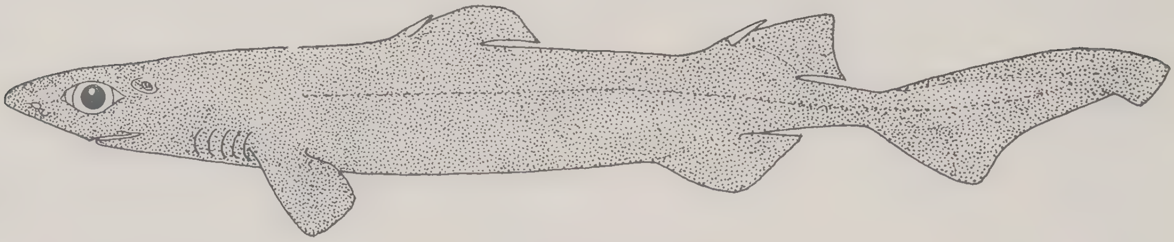
Centroscyllium fabricii (Reinhardt, 1825)

SQUAL Centro 1

Spinax fabricii Reinhardt, 1825, Overs.K.danske Vidensk.Selsk.Forh., (1824-1825):3. Holotype : One syntype, Universitetets Zoologiske Museum, Copenhagen, ZMUC 185. Type Locality : Julianehaab, West Greenland.

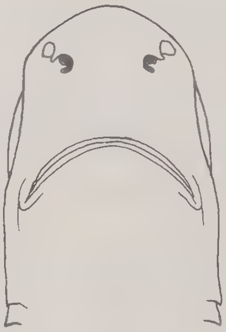
Synonymy : None.

FAO Names : En - Black dogfish; Fr - Aiguillat noir; Sp - Tollo negro merga.



Field Marks : No anal fin, grooved dorsal fin spines, teeth with narrow cusps and cusplets in upper and lower jaws. Colour uniformly blackish-brown without white markings, abdomen long, caudal peduncle short.

Diagnostic Features : Body moderately stout and compressed. Preoral snout moderately long, about 2/3 of distance from centre of mouth to pectoral origins; mouth moderately arched, about a third as long as wide. Second dorsal fin considerably larger than first; pectoral apices when laid back ending well anterior to first dorsal spine origin. Caudal peduncle short, distance from second dorsal insertion to upper caudal origin about as long as distance from eye to first gill slits. Lateral trunk denticles close-set, conical and with hooked cusps. Colour blackish brown above and below, without conspicuous black markings on ventral surface or sides of tail; fins without white markings. Size large, adults to possibly a metre.



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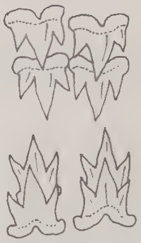
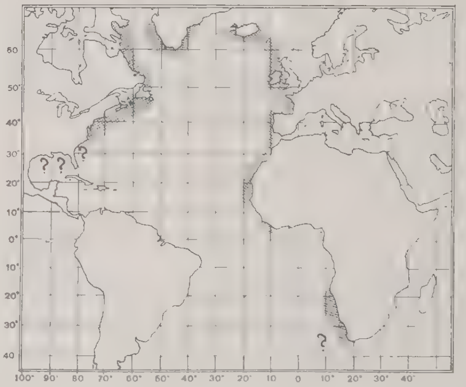


upper and lower teeth

Geographical Distribution : Western North Atlantic: S. Baffin Island and Greenland to Virginia (USA) and possibly Gulf of Mexico. Eastern Atlantic: Iceland along Atlantic slope to Senegal, Guinea to Sierra Leone, Namibia and the southwestern Cape coast of South Africa.



Habitat and Biology : An abundant deepwater schooling shark of the outermost continental shelves and upper slopes at depth mostly below 275 m and ranging from 180 m to about 1600 m; at high latitudes, it may move up to near the surface, especially during the winter and when darkest. At the northern extremes of its range this species does not range into truely Arctic waters but occurs on their fringe in the boreal North Atlantic. Water temperatures at the bottom where these sharks are most commonly caught are 3.5 to 4.5°C, but sometimes down to 1°C. There is some evidence of segregation by sex and size within populations and of movements of schools into shallower water and increase in school size during winter and spring. This species is ovoviviparous, with embryos to at least 14 cm.

This shark has luminescent organs scattered in its skin, but apparently not arranged in regular arrays like other species. Food organisms reported include pelagic crustaceans, cephalopods, and jellyfish; presumably small deepwater fishes are also eaten.

Size : Maximum total length at least 84 cm, may reach 107 cm; adult females reported at 58 to 70 cm.

Interest to Fisheries : Abundant in the North Atlantic and commonly taken by bottom trawls and with line gear, but apparently little utilized.

Literature : Bigelow & Schroeder (1948, 1957); Templeman (1963); Krefft & Stehmann (1973); Cadenat & Blache (1981).

Remarks : Records of this species from tropical west Africa and southwestern Africa need confirmation.

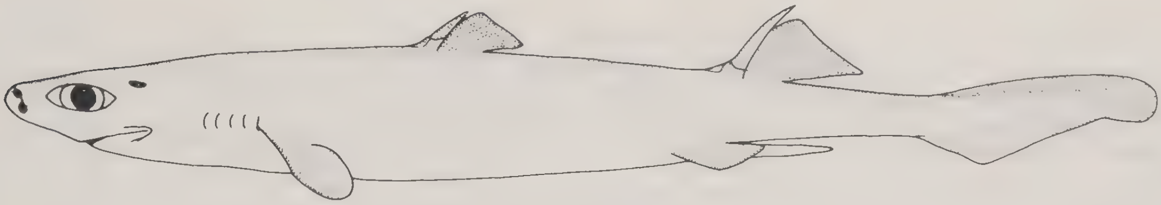
Centroscyllium granulatum Günther, 1887

SQUAL Centro 2

Centroscyllium granulatum Günther, 1887, Rep.Sci.Res.Voy.H.M.S."Challenger", Zool. 22:7. Holotype : British Museum (Natural History), BMNH 1887.12.7.2, 265 mm (11 inches or 279 mm, in original account, adult male. Type Locality : Port Stanley, Falkland Islands, 448 m depth.

Synonymy : None.

FAO Names : En - Granular dogfish; Fr - Aiguillat râpe; Sp - Tollo negro raspa.



Field Marks : No anal fin, grooved dorsal fin spines, teeth with narrow cusps and cusplets in upper and lower jaws, uniformly brownish-black coloration without conspicuous markings, long abdomen, long caudal peduncle and dwarf size.

Diagnostic Features : Body moderately stout and compressed. Preoral snout moderately long, about 3/5 of distance from mouth to pectoral origins; mouth rather narrowly arched, nearly half as long as wide. Second dorsal fin much larger than first; pectoral apices when laid back ending well anterior to first dorsal spine origin. Caudal peduncle elongated, distance from second dorsal insertion to upper caudal origin about as long as distance from eye to pectoral origins. Lateral trunk denticles close-set, conical and with hooked cusps. Colour brownish-black above and below, without conspicuous black areas on underside of body or caudal peduncle; fins plain. Size small, adults below 30 cm.

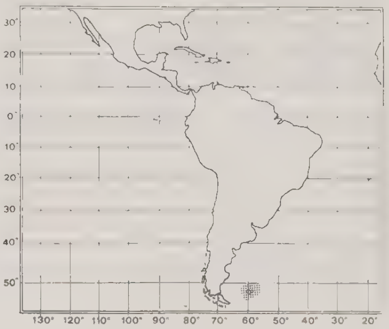
Geographical Distribution : Western South Atlantic: Falkland Islands/ Malvinas.

Habitat and Biology : A poorly known deepwater shark caught off the Falkland Islands slope at 448 m.

Size : Maximum total length at least 28 cm (adult male holotype).

Interest to Fisheries : None.

Literature : Bigelow & Schroeder (1957); Cadenat & Blache (1981).



Remarks : This species has been confused with Etmopterus granulosus (Günther, 1880) but is quite distinct (Krefft, 1968a). The writer examined the holotypes of both species in the British Museum (Natural History), and was able to confirm the validity of this species.

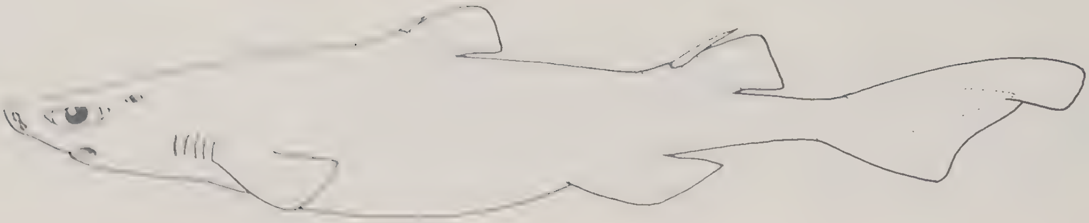
Centroscyllium kamoharai Abe, 1966

SQUAL Centro 3

Centroscyllium kamoharai Abe, 1966, Jap.J.Ichthyol., 13(416):190, figs 1-8. Holotype : Zoological Institute, Faculty of Science, University of Tokyo no. 52310, 440 mm adult female. Type Locality : Suruga Bay, off Yaizu, Honshu, Japan.

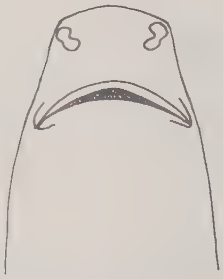
Synonymy : None.

FAO Names : En - Bareskin dogfish; Fr - Aiguillat lisse; Sp - Tollo negro liso.



Field Marks : No anal fin, grooved dorsal fin spines, teeth with narrow cusps and cusplets in upper and lower jaws, uniform dark coloration except for white-tipped fins, long abdomen and short caudal peduncle, wide-spaced denticles on body.

Diagnostic Features : Body stout and compressed. Preoral snout moderately long, about 3/5 of distance from mouth to pectoral origins; mouth extremely short and very broadly arched, less than a third as long as wide. Second dorsal fin slightly larger than first; pectoral apices when laid back fall well anterior to first dorsal spine origin. Caudal peduncle short, distance from second dorsal insertion to upper caudal origin about as long as distance from eye to third gill slits. Lateral trunk denticles wide-spaced and sparse on body, which is almost naked, conical and with hooked cusps. Colour uniform blackish. Size moderate, adults to about 44 cm.



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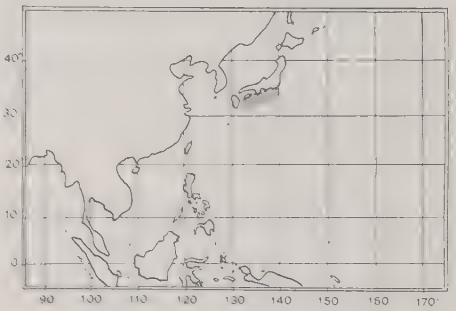
Geographical Distribution : Western North Pacific: Japan (southeastern Honshu).

Habitat and Biology : A little-known deepwater dogfish, depth not reported.

Size : Maximum total length reported 44 cm, females mature at 42 to 44 cm, males unknown.

Interest to Fisheries : None.

Literature : Abe (1966).



Centroscyllium nigrum Garman, 1899

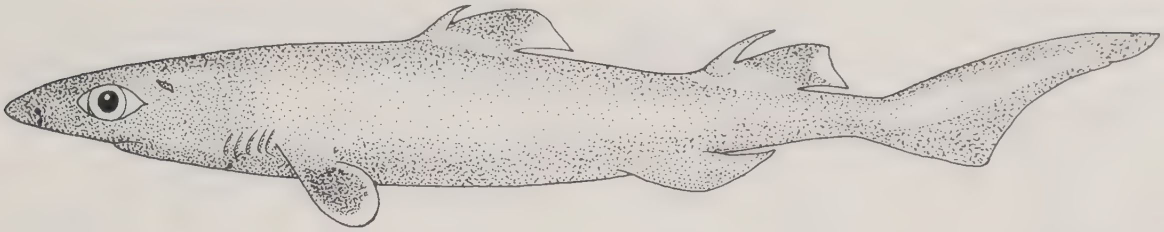
SQUAL Centro 4

Centroscyllium nigrum Garman, 1899, Mem.Mus.Comp.Zool.Harv.Coll., 24:28, pl. 1, fig. 2, pls. 4-5, pl. 69, fig. 2. Holotype : Two specimens mentioned, 11 1/2 and 4 3/4 inches long, but no type designated; presumably the first of these specimens is the holotype). Type Locality : Two localities mentioned, 70°9'30"N, 81°8'30"W, 779 m, and 6°30'N, 81°44'W, 1016 m, both off Panama, without reference to specimens.

Synonymy : Centroscyllium ruscosum Gilbert, 1905.

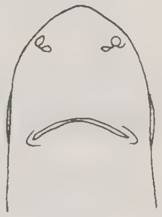
Other Scientific Names Recently in Use : Centroscyllium granulosum (not Günther, 1880 = Etmopterus granulosus).

FAO Names : En - Combtooth dogfish; Fr - Aiguillat peigne; Sp - Tollo negro peine.



Field Marks : No anal fin, grooved dorsal fin spines, teeth with narrow cusps and cusplets in upper and lower jaws, uniform dark coloration except for white-tipped fins, short abdomen and short caudal peduncle, close-set denticles on body.

Diagnostic Features : Body moderately stout and compressed. Preoral snout moderately long, about 2/3 of distance from mouth to pectoral origins; mouth very broadly arches, less than a third as long as wide. Second dorsal fin about as large as first; pectoral apices when laid back ending just anterior to first dorsal spine origin. Caudal peduncle short, distance from second dorsal insertion to upper caudal origin about as long as distance from eye to first gill slits. Lateral trunk denticles close-set, conical and with hooked cusps. Colour blackish except for white-tipped fins, no prominent black markings on underside of body and sides of tail. Size moderate, adults to about 50 cm.



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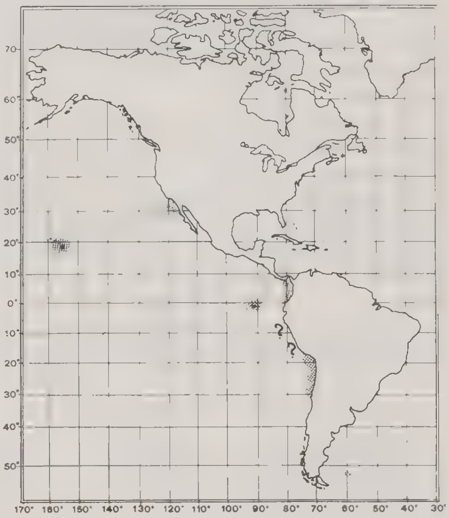
Geographical Distribution : Central Pacific: Hawaiian Islands. Eastern Pacific: southern California (USA), Panama, Cocos Islands, Columbia, Ecuador, northern and central Chile, Galapagos Islands.



Habitat and Biology : A little-known deepwater dogfish of the eastern Pacific and Hawaiian continental and insular slopes, on or near the bottom at depths of 400 to 1143 m.

Size : Maximum total length 50 cm, males adult at 35 to 39 cm, females to at least 50 cm.

Interest to Fisheries : None. In California incidentally caught in sablefish (Anoplopoma) traps, but not utilized.

Literature : Bigelow & Schroeder (1957); Kato, Springer & Wagner (1967).

Remarks : This species has been confused with Etmopterus granulosus (Günther, 1880), and Centroscyllium granulatum (Günther, 1887), but is quite distinct.

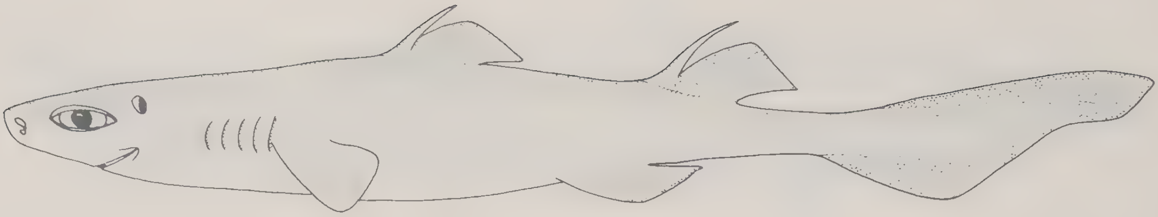
Centroscyllium ornatum (Alcock, 1889)

SQUAL Centro 5

Paracentroscyllium ornatum Alcock, 1889, Ann.Mag.Nat.Hist., ser.6, 4:379. Syntypes : Three syntypes, Zoological Survey of India, Calcutta, ZSI 11664 and 11666 damaged, about 120 mm; and ZSI 11665 (now in British Museum (Natural History) collection). Type Locality : Bay of Bengal, Swatch of No-ground, 741 to 522 m.

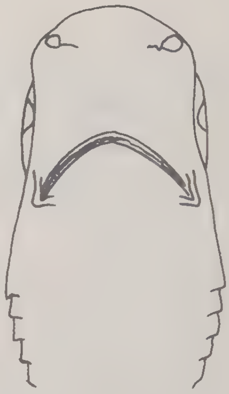
Synonymy : None.

FAO Names : En - Ornate dogfish; Fr - Aiguillat élégant; Sp - Tollo negro elegante.



Field Marks : No anal fin, grooved dorsal fin spines, teeth with narrow cusps and cusplets in upper and lower jaws, uniform dark coloration, short abdomen and short caudal peduncle, close-set denticles on body.

Diagnostic Features : Body moderately stout and compressed. Preoral snout moderately long, about half of distance from mouth to pectoral origins; mouth narrowly arched, nearly half as high as wide. Second dorsal fin somewhat larger than first; pectoral apices when laid back ending about opposite to first dorsal spine origin. Caudal peduncle moderately long, distance from second dorsal insertion to upper caudal origin about as long as distance from eye to third gill slits. Lateral trunk denticles close-set, conical and with hooked cusps. Colour blackish, without white fin tips or prominent black markings on underside of body and sides of tail. Size moderate, adults to about 50 cm.



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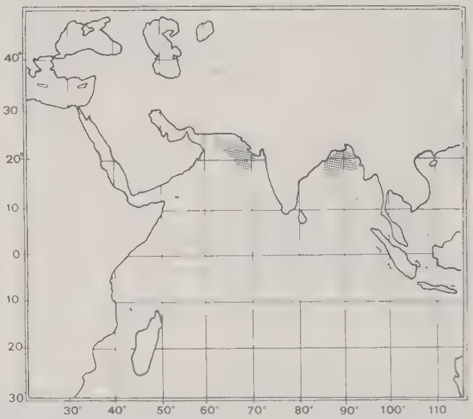
Geographical Distribution : Northern Indian Ocean: Arabian Sea and Bay of Bengal.

Habitat and Biology : A little-known deepwater dogfish from the upper continental slopes of India near bottom at depths from 521 to 1262 m.

Size : Maximum total length to 30 cm (immature?).

Interest to Fisheries : None.

Literature : Fowler (1941); Bigelow & Schroeder (1957).



Remarks : The writer examined two of the syntypes and other material of this species in the Zoological Survey of India, Calcutta, in 1982. The illustration is a reconstruction based on the syntypes and other data.

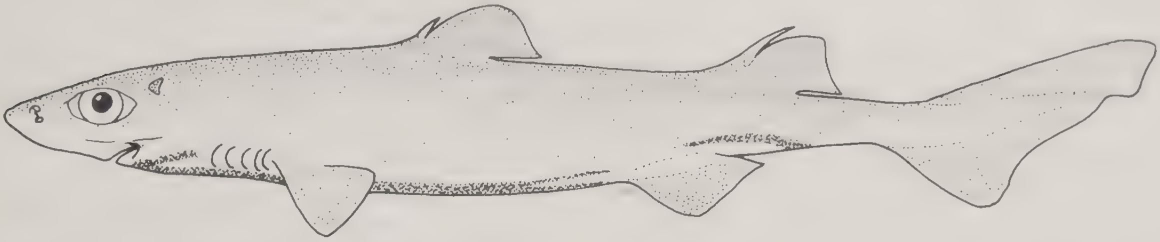
Centroscyllium ritteri Jordan & Fowler, 1903

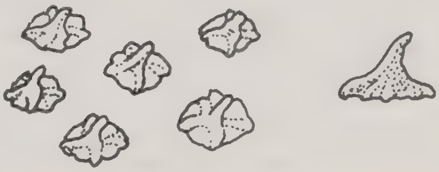
SQUAL Centro 6

Centroscyllium ritteri Jordan & Fowler, 1903, Proc.U.S.Nat.Mus., 26(1324):635, fig. 6. Holotype : Stanford University SU-7185, 430 mm immature female. Type Locality : Misaki, Japan.

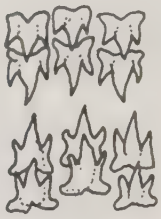
Synonymy : None.

FAO Names : En - Whitefin dogfish; Fr - Aiguillat à nageoires blanches; Sp - Tollo negro aliblanco.





dermal denticles



upper and lower teeth

Field Marks : No anal fin, grooved dorsal fin spines, teeth with narrow cusps and cusplets in upper and lower jaws, abrupt black markings on underside of body.

Diagnostic Features : Body moderately stout and compressed. Preoral snout moderately long, about 2/3 of distance from mouth to pectoral origins; mouth very broadly arched, less than a third as long as wide. Second dorsal fin about as large as first; pectoral apices when laid back ending well anterior to first dorsal spine origin. Caudal peduncle elongated, distance from second dorsal insertion to upper caudal origin about as long as distance from eye to pectoral origins. Lateral trunk denticles close-set, conical and with hooked cusps. Colour grey-brown above, abruptly blackish on underside of head and abdomen, with a black stripe on underside of caudal peduncle extending over pelvic bases (black areas include concentrations of photophores); fins white-edged. Size moderate, adults to 43 cm.

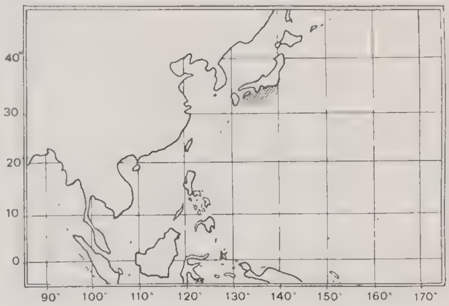
Geographical Distribution : Western North Pacific: Japan (southeastern Honshu).

Habitat and Biology : A little-known distinctive deepwater dogfish, biology almost totally unknown.

Size : Maximum total length about 43 cm, females mature at 42 or 43 cm.

Interest to Fisheries : Apparently none.

Literature : Fowler (1949); Bigelow & Schroeder (1957).



Centroscymnus Bocage & Capello, 1864

SQUAL Centros

Genus : Centroscymnus Bocage & Capello, 1864, Proc.Zool.Soc.London, 24:263.

Type Species : Centroscymnus coelolepis Bocage & Capello, 1864, by monotypy.

Synonymy : Genus Centroselachus Garman, 1913; Subgenus Proscymnodon Fowler, 1934 (Genus Scymnodon Bocage & Capello, 1864).

Field Marks : Greyish or blackish-brown, no anal fin, small fin spines present on both dorsal fins though sometimes inconspicuous (C. cryptacanthus), short to moderately long snout, slender-cusped teeth without cusplets in upper jaw, bladelike, oblique and short-cusped, interlocked cutting teeth in lower jaw, caudal fin with a strong subterminal notch, and pectoral fins with broadly rounded free rear tips.

Diagnostic Features : Anterior nasal flaps short, not expanded as barbels; snout flattened, broadly parabolic, length varying from about equal to distance from mouth to pectoral origins to considerably less than that space, and about half length of head or less; gill openings moderately wide and about equal-sized; lips thick but not pleated or suctorial; teeth very different in upper and lower jaws, uppers with very slender, acute cusps and no cusplets, not bladelike, lower teeth high compressed, bladelike, interlocked with short, oblique cusps, distal blades, and no cusplets; tooth rows 39 to 70/32 to 42. Small, grooved finspines present on both dorsal fins, these sometimes covered with skin and inconspicuous; first dorsal origin varying from over the pectoral bases to well posterior to their free rear tips, insertion well in front of pelvic origins and closer to the pectoral bases than the pelvic bases; second dorsal origin about over the middle of the pelvic bases; second dorsal about as large or slightly smaller than first, but first often with an anteriorly elongated base up to about twice as long as that of first; pectoral fins with short, broadly rounded free rear tips and inner margins, not broadly lobate or acute and attenuated; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe short but well-developed, subterminal notch present and strong. No precaudal pits or lateral keels on caudal peduncle. Dermal denticles with low, pedicellate, flat, ovoid crowns, varying from triridged and tricuspid to smooth and acuspidate in adults, triridged and tricuspidate in young. Cloaca without a luminous gland. Colour blackish brown or greyish brown above and below.

Remarks : The separation of this genus from Scymnodon is unsatisfactory with criteria in current usage, but I hesitate to merge them pending further work on the problem. I use Bigelow & Schroeder's (1957) rather than Garrick's (1959a,b) or Bass, d'Aubrey & Kistnasamy's (1976) limits for the two genera, and include only species with very long cusps on their lower teeth in Scymnodon (S. ringens, S. obscurus, and S. squamulosus). Centroscymnus as presently delimited includes C. coelolepis, C. crepidater, C. cryptacanthus, C. macracanthus, C. owstoni, and C. plunketi. An additional species, C. fuscus Gilchrist & von Bonde, 1924, was placed in synonymy of Centrophorus squamosus by Bass, d'Aubrey & Kistnasamy (1976).

Key to Species :

1a. Snout greatly elongated, preoral length about equal to distance from mouth to pectoral fin origins. Upper labial furrows greatly elongated, their lengths greater than distance between their anterior ends .... **C. crepidater**

1b. Snout shorter, preoral length much less than distance from mouth to pectoral fin origins. Upper labial furrows shorter, their lengths less than distance between their anterior ends

  2a. Snout moderately long, preoral length about as long as distance from mouth to first gill slits, and about equal to mouth width

    3a. Dorsal fin spines rather stout and prominent, exposed anterior margin of first spine nearly half length of fin base from insertion to rear end of spine. Body strongly tapering rearwards from pectoral fins. Pectoral fins large, their apices nearly or quite reaching first dorsal spine when laid back .... **C. macracanthus**

    3b. Dorsal fin spines inconspicuous, with only tips slightly protruding or not at all. Body not tapering from pectoral fins, dorsoventral contours nearly parallel to pelvic bases. Pectoral fins smaller, their apices falling well ahead of first dorsal spine when laid back.

      4a. Dorsal fin spines usually concealed by skin. Base of first dorsal fin extending anteriorly as a conspicuous broad ridge to over the pectoral bases .... **C. cryptacanthus**

      4b. Dorsal fin spines with tips usually exposed. Base of first dorsal fin little exended anteriorly as a low ridge to behind pectoral rear tips .... **C. owstoni**

  2b. Snout short, preoral length about 2/3 as long as distance from mouth to first gill slits, and less than mouth width

    5a. Lateral trunk denticles very large, with smooth, rounded crowns in adults, resembling bony fish scales. Body not tapering from pectoral fins, dorsoventral contours nearly parallel to pelvic bases. First dorsal base not expanded forwards, origin of fin well behind pectoral rear tips .... **C. coelolepis**

    5b. Lateral trunk denticles small and with tricuspidate ridged crowns in adults, not resembling bony fish scales. Body tapering posteriorly from pectoral fins. First dorsal base expanded forward, origin of fin about opposite pectoral rear tips .... **C. plunketi**

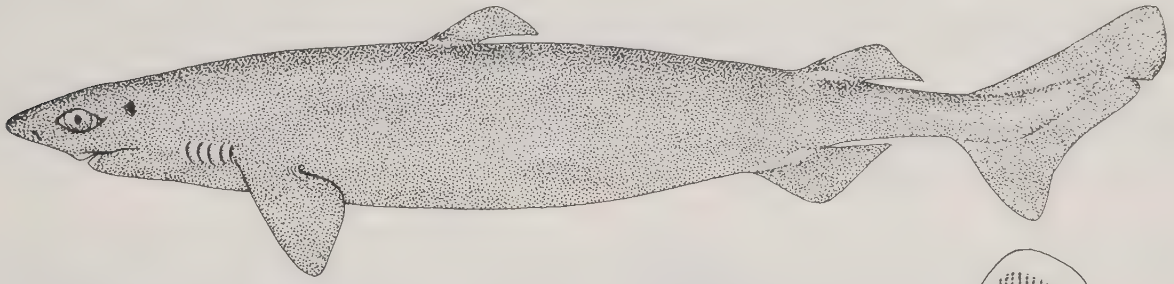
Centroscymnus coelolepis Bocage & Capello, 1864

SQUAL Centros 1

Centroscymnus coelolepis Bocage & Capello, 1864, Proc.Zool.Soc.Lond., 24:263, fig. 4. Holotype : Museu Bocage, Lisbon, Portugal, MB T 113, lost in fire. Type Locality : Off Portugal.

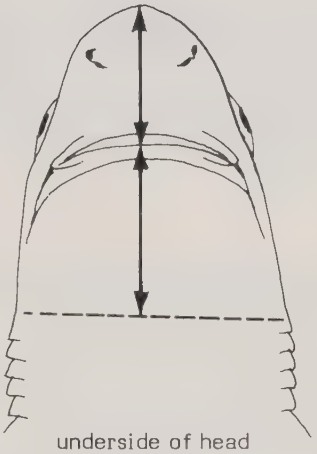
Synonymy : Scymnodon melas Bigelow, Schroeder & Springer, 1953; ? Centroscymnus macrops Chu et al., 1982.

FAO Names : En - Portuguese dogfish; Fr - Pailona commun; Sp - Pailona.



Field Marks : Dark brown coloration, no anal fin, dorsal fins with very small fin spines, very short snout, lanceolate upper teeth and bladelike lower teeth with short, oblique cusps, stocky body that does not taper abruptly from pectoral region, very large lateral trunk denticles with smooth, circular, acuspidate crowns in adults and subadults.

Diagnostic Features : Body stocky, not strongly tapering back from pectoral region. Snout short, preoral length much less than distance from mouth to first gill slits and less than mouth width; lips not thick and fleshy; upper labial furrows very short, their lengths much less than distance between their front ends; lower teeth with very short, strongly oblique cusps and high, narrow roots. Dorsal fins about equal in size and height, fin spines very small but with tips protruding from fins; first dorsal base not extending forwards as a prominent ridge, origin behind pectorals; second dorsal base shorter than space between it and upper caudal origin, free rear tip well in front of upper caudal origin; pectoral fins moderately large, apices falling well in front of first dorsal spine when laid back; free rear tips of pelvic fins extending behind second dorsal insertion. Lateral trunk denticles very large, with smooth, circular, ridgeless and acuspidate crowns, giving shark an almost teleostlike appearance. Colour blackish brown.



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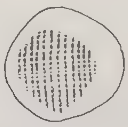
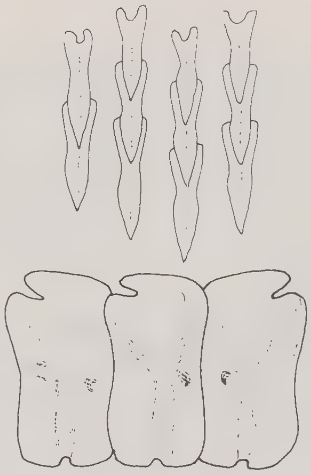


dermal denticle

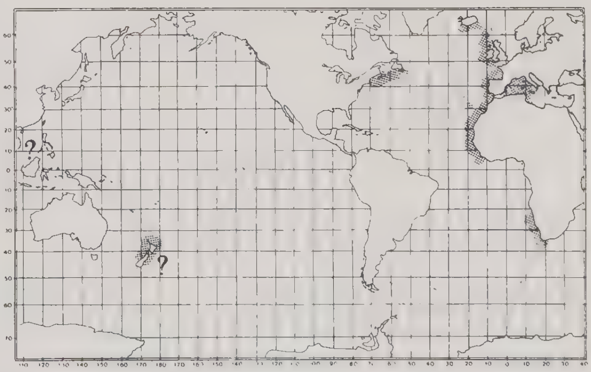


upper and lower teeth

Geographical Distribution : Western North Atlantic: Grand Banks to Delaware Bay. Eastern Atlantic: Iceland south along Atlantic slope to Senegal, Azores, Madeira, Guinea to Sierra Leone, and southern Namibia to the southwestern Cape coast of South Africa; also western Mediterranean. Western Pacific: ? South China Sea, New Zealand.

Habitat and Biology : A common, wide-ranging but little-known deepwater shark, on or near the bottom on the continental slopes. Recorded mostly at depths below 400 m, with a depth range of 270 to 3675 m. Lives at water temperatures of 5 to 13°C. Development ovoviviparous, with 13 to 16 young per litter. Eats bony fishes.

Size : Maximum total length about 114 cm, most adults about 90 to 95 cm.



Interest to Fisheries : A common deepwater shark, caught in bottom trawls, deepwater fixed nets, and line gear. Utilized in the eastern Atlantic for fishmeal, and dried salted for human consumption.

Literature : Bigelow & Schroeder (1948, 1957); Krefft & Stehmann (1973); Cadenat & Blache (1981); Compagno (1981).

Remarks : Chu et al. (1982) recently described a new species of Centroscymnus, C. macrops, that is very close to and possibly identical to this species. J.A.F. Garrick (pers. comm.) has records of C. coelolepis itself from New Zealand.

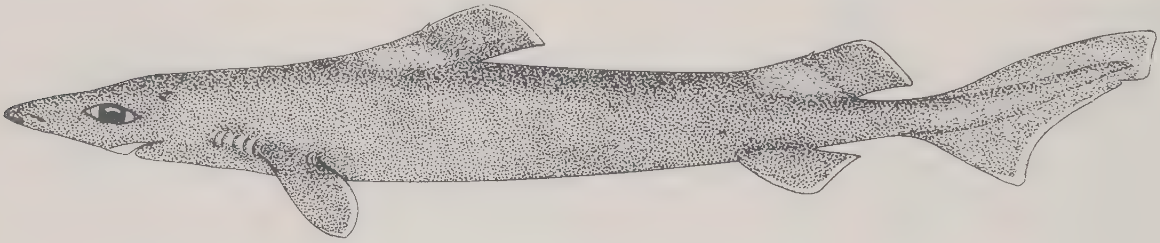
Centroscymnus crepidater (Bocage & Capello, 1864)

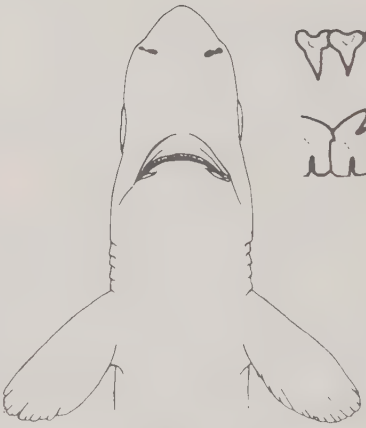
SQUAL Centros 2

Centrophorus crepidater Bocage & Capello, 1864, Proc.Zool.Soc.Lond., 24:262, fig. 3. Holotype : Museu Bocage, Lisbon, Portugal, MB T112(49), lost in fire. Type Locality : Off Portugal.

Synonymy : Centrophorus rossi Alcock, 1898; Centrophorus jonsonii Saemundsson, 1922; Centroscymnus furvescens De Buen, 1959.

FAO Names : En - Longnose velvet dogfish; Fr - Pailona à long nez; Sp - Sapata negra.





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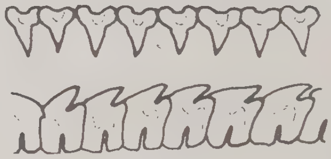
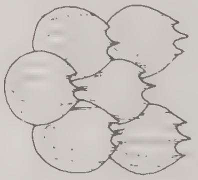


upper and lower teeth

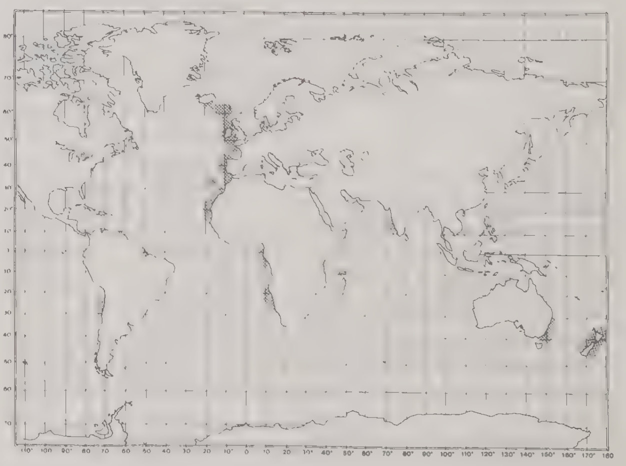


dermal denticles

Field Marks : Black or blackish brown coloration, no anal fin, dorsal fins with very small fin spines, very long snout, greatly elongated labial furrows that nearly encircle mouth, lanceolate upper teeth and bladelike lower teeth with moderately long, oblique cusps, fairly slender body that does not taper abruptly from pectoral region, moderately large lateral trunk denticles with partly smooth, oval, cuspidate crowns in adults and subadults.

Diagnostic Features : Body fairly slender, not strongly tapering back from pectoral region. Snout very long, preoral length about equal to distance from mouth to pectoral origins and much greater than mouth width; lips not thick and fleshy; upper labial furrows very long, their lengths greater than distance between their front ends; lower teeth with moderately long, semioblique cusps and moderately high, fairly broad roots. Dorsal fins about equal in size and height, fin spines very small but with tips protruding from fins; first dorsal base expanded forwards as a prominent ridge, origin over pectoral bases; second dorsal base longer than space between it and upper caudal origin, free rear tip nearly reaching upper caudal origin; pectoral fins moderately large, apices falling well in front of first dorsal spine when laid back; free rear tips of pelvic fins extending to about opposite second dorsal insertion. Lateral trunk denticles moderately large, with anteriorly smooth but posteriorly ridged, oval, cuspidate crowns. Colour blackish brown.

Geographical Distribution : Eastern Atlantic: Iceland, Faeroe Islands along Atlantic slope to Portugal, Senegal, Madeira, Gabon to Zaire, Namibia. Indian Ocean : Aldabra Islands, India (Travancore Coast). Western Pacific: New Zealand, Australia (New South Wales). Eastern Pacific: Northern Chile.



Habitat and Biology : A little-known but fairly common deepwater dogfish of singular appearance, found on the upper continental slopes on or near the bottom at depths of 270 to 1070 m. Ovoviviparous, with 4 young in a litter. Eats lanternfishes.

Size : Maximum total length about 90 cm, males mature at 64 to 68 cm, females at 82 cm.

Interest to Fisheries : Caught in bottom trawls in the eastern Atlantic, and utilized there for fishmeal.

Literature : Bigelow & Schroeder (1948, 1957); Garrick (1959); Krefft & Stehmann (1973); Cadenat & Blache (1981); Compagno (1981).

Remarks : The possible synonymy of *Centrophorus rossi* with this species was discussed by Bigelow & Schroeder (1957) and Garrick (1959a), who preferred to recognize *C. rossi* because of its supposedly longer head. The writer examined the holotype of *C. rossi* in the Zoological Survey of India, Calcutta, ZSI F 225/1 (233 mm female possibly newborn) and found that its head length, 29.6% of total length, fell in the range reported for *C. crepidater* by Cadenat & Blache (1981), 21.3 to 29.7% of total length. As the specimen apparently has no other characters that distinguish it from *C. crepidater*, *C. rossi* is synonymized with *C. crepidater* here. The holotype of *C. rossi* is not the only record of this species from the Western Indian Ocean, as records of *C. owstoni* from the Aldabra Island group by Forster *et al.* (1970) were based on *C. crepidater* (Drs J. Bass and P.C. Heemstra, pers.comm.).

Although Cadenat & Blache (1981) recognized *C. furvescens* as a separate species on its slightly shorter preoral snout (10.5% of total length, vs 11.4 to 15.5% for specimens of *C. crepidater*), the difference is so slight and intraspecific variation in *C. crepidater* is sufficiently great for me to retain *C. furvescens* in synonymy of *C. crepidater*, following Kato, Springer & Wagner (1967).

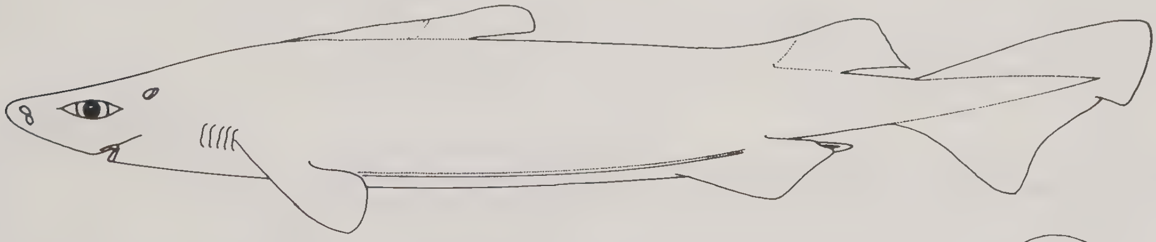
Centroscymnus cryptacanthus Regan, 1906

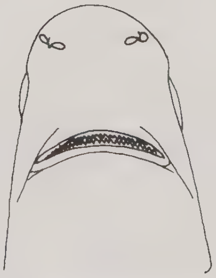
SQUAL Centros 3

Centroscymnus cryptacanthus Regan, 1906b, *Ann.Mag.Nat.Hist., (Ser. 7)*, 18(108):437. Holotype : British Museum (Natural History), BMNH 1865.5.20.4, 780 mm adult male. Type Locality : Madeira, eastern Atlantic.

Synonymy : None

FAO Names : En - Shortnose velvet dogfish; Fr - Pailona sans épine; Sp - Pailona ñata.





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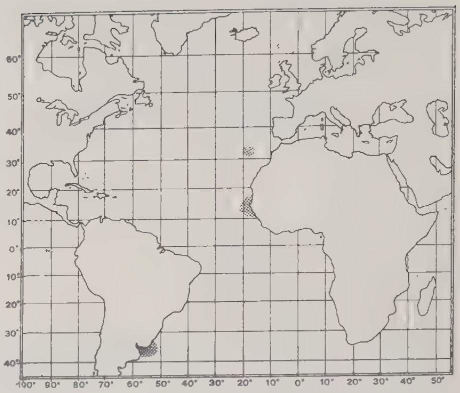
Field Marks : Black coloration, no anal fin, dorsal fins with fin spines usually buried in the fins, moderately long snout, lanceolate upper teeth and bladelike lower teeth with short, oblique cusps, fairly stocky body that does not taper abruptly from pectoral region, large lateral trunks denticles with mostly smooth, circular, cuspidate and acuspidate crowns in adults and subadults.

Diagnostic Features : Body stocky, not strongly tapering back from pectoral region. Snout moderately long, preoral length about as long as distance from mouth to first gill slits and about equal to mouth width; lips moderately thick and fleshy; upper labial furrows very short, their lengths much less than distance between their front ends; lower teeth with short, oblique cusps and fairly high, narrow roots. Second dorsal fin considerably higher than first, fin spines small and usually buried in fins. First dorsal base extending forward as a prominent ridge, origin over pectoral bases; second dorsal base much longer than space between it and upper caudal origin, free rear tip about opposite upper caudal origin; pectoral fins moderately large, apices falling well in front of first dorsal spine when laid back; free rear tips of pelvic fins below second dorsal insertion. Lateral trunk denticles large, with mostly smooth, circular ridgeless and acuspidate or medially cuspidate crowns. Colour blackish or dark brown.

Geographical Distribution : Western South Atlantic: Uruguay. Eastern North Atlantic: Madeira, Senegal.



Habitat and Biology : A little-known deepwater dogfish of the upper continental slopes from 400 to 1164 m, found on or near the bottom.

Size : Maximum total length about 104 cm, adult males 72 to 84 cm, adult females 102 to 104 cm.

Interest to Fisheries : Apparently of little importance, occasionally taken by trawlers in the eastern Atlantic.

Literature : Bigelow & Schroeder (1957); Krefft (1968); Cadenat & Blache (1981); N. Merrett (pers. comm.).

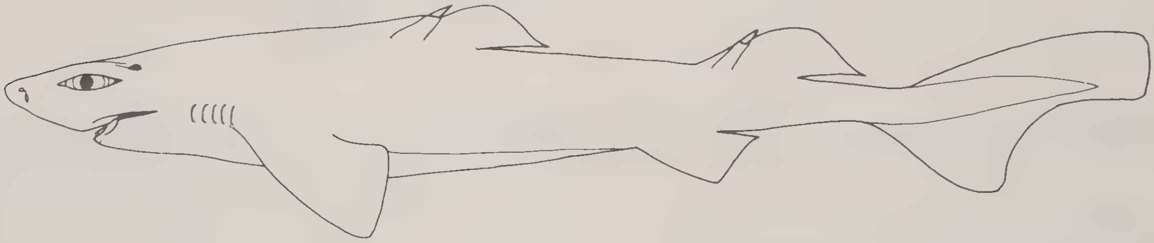
Centroscymnus macracanthus Regan, 1906

SQUAL Centros 4

Centroscymnus macracanthus Regan, 1906b, Ann.Mag.Nat.Hist., (Ser. 7), 18(108):436. **Holotype :** British Museum (Natural History) BMNH-1184.2.6.7, 680 mm female. **Type Locality :** "Magellan" (Straits of Magellan).

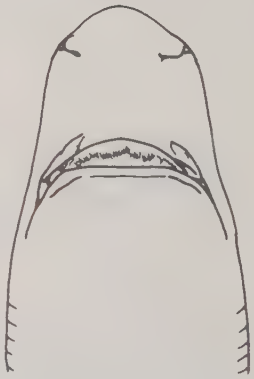
Synonymy : Etmopterus paessleri Lönnberg, 1907.

FAO Names : En - Largespine velvet dogfish; Fr - Pailona jume; Sp - Sapata espinuda.



Field Marks : Dark brown or blackish coloration, no anal fin, dorsal fins with fairly prominent fin spines, moderately long snout, lanceolate upper teeth and bladelike lower teeth with short, oblique cusps, stocky body that tapers abruptly from pectoral region, and moderately large tricuspidate and tricarinate lateral trunk denticles.

Diagnostic Features : Body stocky, strongly tapering back from pectoral region. Snout moderately long, preoral length about equal to distance from mouth to first gill slits and equal to mouth width; lips thick and fleshy; upper labial furrows very short, their lengths much less than distance between their front ends; lower teeth with short, oblique cusps and moderately high, fairly broad roots. Second dorsal fin somewhat higher than first, fin spines stout and with at least a third of their lengths protruding from fins; first dorsal fin not extending forwards as a prominent ridge, origin over pectoral bases; second dorsal base about as long as space between it and upper caudal origin, free rear tip well in front of upper caudal origin; pectoral fins large, apices falling about opposite first dorsal spine when laid back; free rear tips of pelvic fins falling well in front of second dorsal insertion. Lateral trunk denticles large, with strong triple ridges and cusps in the holotype and only extant specimen.



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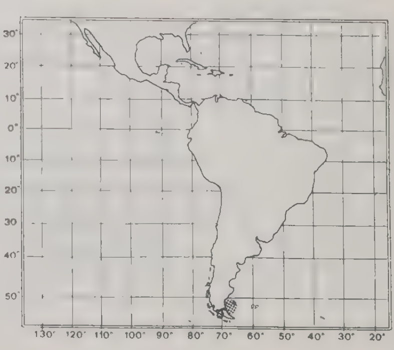
Geographical Distribution : Western South Atlantic: Straits of Magellan.



Habitat and Biology : A poorly known deepwater dogfish, known at present only from the holotype from the Straits of Magellan, depth not recorded.

Size : The holotype and only known specimen is 68 cm long; presumably the species attains a larger size than this, but this is uncertain.

Interest to Fisheries : None.

Literature : Regan (1906); Lönnberg (1907); Bigelow & Schroeder (1957).

Remarks : The writer examined the holotype in the British Museum (Natural History), upon which the illustration and present account is based. Lönnberg (1907) described Etmopterus paessleri from Smyth Channel in the Straits of Magellan, from three small syntypes deposited in the Zoologisches Museum of the University of Hamburg. These are apparently lost (Krefft, 1968), but Lönnberg presented a photograph in dorsal view of one of the syntypes. This species was accepted as an aberrant species of Etmopterus by Regan (1908), Garman (1913), and Bigelow & Schroeder (1957), but careful consideration of Lönnberg's description, measurements and illustration, and a lateral-view reconstruction made from this information, caused the writer to strongly suspect that Etmopterus paessleri is a junior synonym of Centroscymnus macracanthus. Particularly the broad head, large pectoral fins, large broad caudal fin, upper teeth without lateral cusplets, denticles with lateral cusps, and second dorsal spine slightly smaller than first, as well as the general morphology of E. paessleri all fit C. macracanthus as studied from the holotype. Hence this species is placed in tentative synonymy of C. macracanthus.

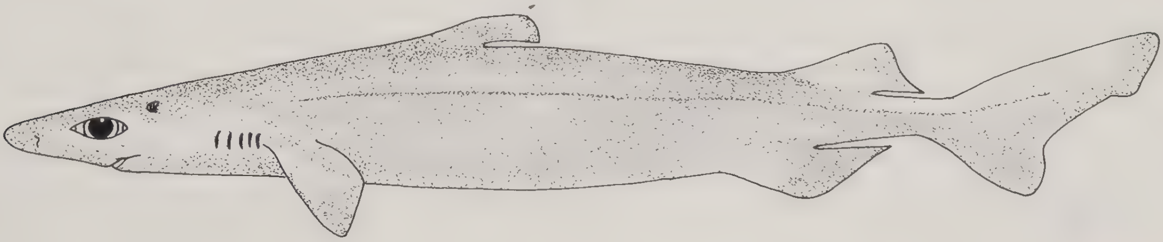
Centroscymnus owstoni Garman, 1906

SQUAL Centros 5

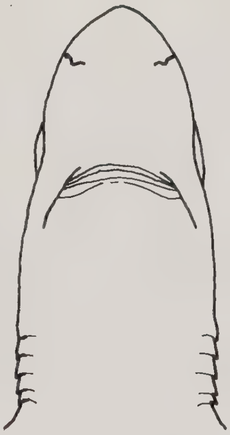
Centroscymnus owstoni Garman, 1906, Bull.Mus.Comp.Zool.Harvard, 46(11):207. Holotype : Museum of Comparative Zoology, Harvard, MCZ-1037, 790 mm. Type Locality : Japan.

Synonymy : None

FAO Names : En - Roughskin dogfish; Fr - Pailona rapeux; Sp - Sapata lija.



Field Marks : Dark brown or black coloration, no anal fin, dorsal fins with extreme tips of fin spines protruding from the fins, moderately long snout, lanceolate upper teeth and bladelike lower teeth with short, oblique cusps, fairly stocky body that does not taper abruptly from pectoral region, large lateral trunk denticles with mostly smooth, circular, cuspidate and acuspidate crowns in adults and subadults.



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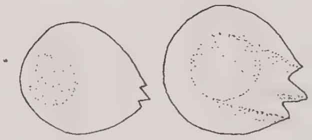
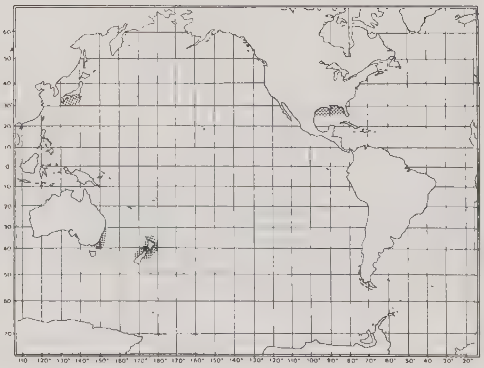


dermal denticles

Diagnostic Features : Body stocky, not strongly tapering back from pectoral region. Snout moderately long, preoral length about as long as distance from mouth to first gill slits and about equal to mouth width; lips moderately thick and fleshy; upper labial furrows very short, their lengths much less than distance between their front ends; lower teeth with short, oblique cusps and fairly high, narrow roots. Second dorsal fin considerably higher than first, fin spines small and with tips protruding from fins; first dorsal fin extending forward as a short and inconspicuous ridge, origin behind pectoral bases; second dorsal base much longer than space between it and upper caudal origin, free rear tip just in front of upper caudal origin; pectoral fins moderately large, apices falling well in front of first dorsal spine when laid back; free rear tips of pelvic fins below or slightly in front of second dorsal insertion. Lateral trunk denticles large, with mostly smooth, oval, partly ridged and cuspidate crowns. Colour blackish or dark brown.



Geographical Distribution : Western North Atlantic: Northern Gulf of Mexico. Western Pacific: Japan (southeastern Honshu), New Zealand, Australia (New South Wales).

Habitat and Biology : A little-known deepwater dogfish of the upper continental slopes at depths of 500 to 1097 m, on or near bottom.

Size : Maximum reported 78 cm (adult male), presumably reaching about 1 m.

Interest to Fisheries : Nothing reported.

Literature : Garman (1913); Bigelow & Schroeder (1957); Garrick (1959); S. Springer (pers. comm.).

Remarks : Specimens of a Centroscymnus of the owstoni-cryptacanthus type from the western North Atlantic have been tentatively assigned this name rather than C. cryptacanthus (S. Springer, pers. comm.). Examination of considerable material of eastern Atlantic Centroscymnus cryptacanthus, including the holotype, suggests that the covered fin spine that primarily separates C. cryptacanthus from this species may be variably covered or uncovered. A record of C. owstoni from the Aldabra Island group, (India) (Forster et al., 1970) was based on C. crepidater (Drs J. Bass & P.C. Heemstra, pers.comm.).

Centroscymnus plunketi (Waite, 1900)

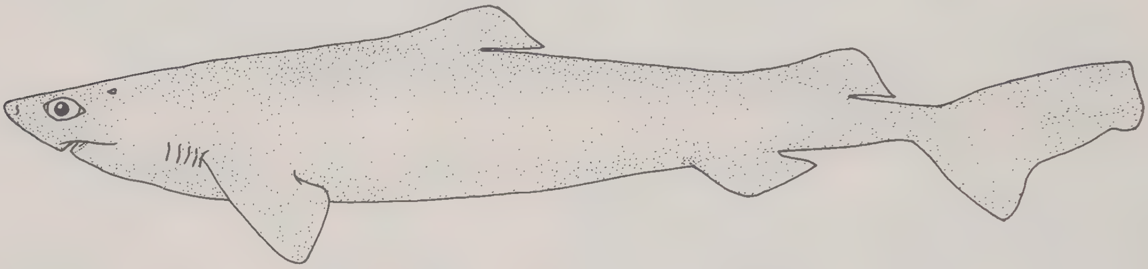
SQUAL Centros 6

Centrophorus plunketi Waite, 1909, Trans.New Zealand Inst., 42:384, figs 1-3. Holotype : Adult female, about 1420 mm. Type Locality : South Island of New Zealand in 220 m depth.

Synonymy : Centrophorus waitei Thompson, 1930

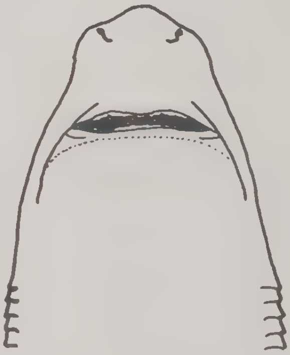
Other Scientific Names Recently in Use : Scymnodon plunketi (Waite, 1909).

FAO Names : En - Plunket shark; Fr - Pailona austral; Sp - Pailona austral.



Field Marks : Dark grey-brown coloration, no anal fin, dorsal fins with very small fin spines, very short snout, lanceolate upper teeth and bladelike lower teeth with short, oblique cusps, stocky body that tapers abruptly from pectoral region, moderately large dermal denticles with triple cusps and ridges in adults and subadults.

Diagnostic Features : Body stocky, tapering back from pectoral region. Snout short, preoral length much less than distance from mouth to first gill slits and less than mouth width; lips not thick and fleshy; upper labial furrows very short, their lengths much less than distance between their front ends; lower teeth with short, strongly oblique cusps and high, fairly broad roots. Dorsal fins about equal in size and height, fin spines very small but with tips protruding from fins; first dorsal fin extending forward as a prominent ridge, origin behind pectorals; second dorsal base about as long as space between it and upper caudal origin, free rear tip well in front of upper caudal origin; pectoral fins moderately large, apices falling well in front of first dorsal spine when laid back; free rear tips of pelvic fins falling well in front of second dorsal insertion. Lateral trunk denticles moderately large, with triple cusps and ridges.



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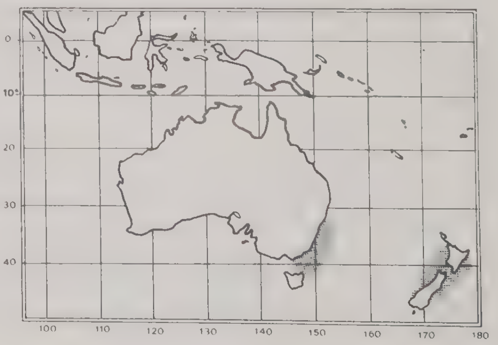
Geographical Distribution : Western South Pacific: South-eastern Australia, New Zealand.



Habitat and Biology : A common though little-known bottom shark of the continental and insular slopes of temperate southeastern Australia and New Zealand, at depths of 219 to 1427 m though commonest between 550 and 732 m. Occurs in large schools near the bottom, with schools segregated by size and sex. Development ovoviviparous, with large litters of up to 36 young. Feeds on cephalopods and bony fishes.

Size : Males mature at 100 to 131 cm total length, females 129 to 170 cm; size at birth between 32 and 36 cm.

Interest to Fisheries : This is a very common deepwater shark off New Zealand in waters deeper than 550 m, which has been taken in considerable numbers with deepwater longlines and is of possible commercial interest for liver oil and fishmeal.

Literature : Whitley (1940); Fowler (1941); Bigelow & Schroeder (1957); Garrick (1959).

Cirrhigaleus, Tanaka, 1912

SQUAL Cirrh

Genus : Cirrhigaleus Tanaka, 1912, Fig.Descr.Fish.Japan, 9:151.

Type Species : Cirrhigaleus barbifer Tanaka, 1912, by original designation.

Synonymy : Genus Phaenopogon Herre, 1935.

Diagnostic Features : Anterior nasal flaps greatly elongated, expanded as long, prominent barbels that reach mouth; snout flattened, short, and broadly rounded, length less than 1/3 head length and much less than distance from mouth to pectoral origins; gill openings moderately broad and about equally wide; lips thin, not pleated or suctorial teeth similar in both jaws, bladelike, interlocked, with a single oblique cusp and distal blade on a low crown and root, upper teeth slightly smaller than lowers, edges smooth; tooth rows 26 or 27/22 or 26. Both dorsal fins with long, stout, ungrooved spines; first dorsal origin just behind free rear tips of pectoral fins, insertion well in front of pelvic origins and slightly closer to pectoral bases than pelvics; second dorsal origin about over free rear tips of pelvics; second dorsal fin about as large as first, base about equally long; pectoral fins with short, narrowly rounded free rear tips, not broadly lobate or acute and attenuated; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe rather short but present, subterminal notch absent or very weak. No precaudal pits but lateral keels present on caudal peduncle. Dermal denticles with low, pedicellate, tricusped and triridged flat crowns. Cloaca without a luminous gland. Colour grey-brown above, whitish below, fins with conspicuous white margins.

Remarks : This genus has been synonymized with Squalus by Garman (1913), Fowler (1941), and lately by Bass, d'Aubrey & Kistnasamy (1976) but is retained provisionally here following Bigelow & Schroeder (1957) and Garrick & Paul (1971a). The genus differs from Squalus only in having extremely long nasal barbels. Bass, d'Aubrey & Kistnasamy (1976) have argued that C. barbifer is morphologically close to Squalus asper in having a second dorsal fin about as large as first (markedly smaller in other species of Squalus), very large denticles, a relatively short and blunt head and snout, precaudal pits absent or weak (variable in S. asper, strong in other species of Squalus), and broad base on medial lobe of anterior nasal flap (not expanded as a barbel, however, in S. asper). Bass, d'Aubrey & Kistnasamy (1976) chose to merge Cirrhigaleus with Squalus and include it, with S. asper, as a fourth species group within the genus (the acanthias, megalops, and blainvillei groups being the three others), but noted that "future authors might well name a subgenus for these two species, or even consider them as properly forming a separate genus ...". This alternative classification, expressed on the generic level, would entail transferral of S. asper to Cirrhigaleus. Bass (1979) reversed this, retaining the genus Cirrhigaleus for C. barbifer, but again noted its close similarity to Squalus asper.

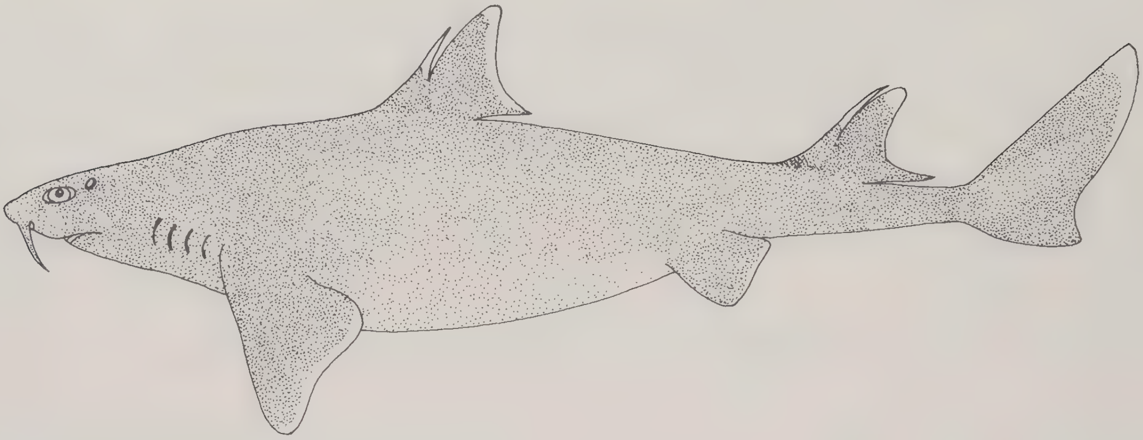
Cirrhigaleus barbifer Tanaka, 1912

SQUAL Cirrh 1

Cirrhigaleus barbifer Tanaka, 1912, Fig.Descr.Fish.Japan, 9:151, pl. 41, figs 156-162. Holotype : Science College Museum, Tokyo, 3397, 855 mm adult male. Type Locality : Southeastern Honshu.

Synonymy : Phaenopogon barbulifer Herre, 1935.

FAO Names : En - Mandarin dogfish; Fr - Squale moustache; Sp - Tollo mandarín.

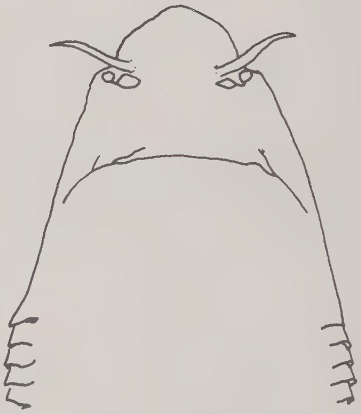


Field Marks : Short snout, tremendously elongated anterior nasal flaps, no anal fin, stout fin spines on both dorsals, low, bladelike cutting teeth in both jaws, very stout body.

Diagnostic Features : See genus.

Geographical Distribution : Western Pacific: Japan (southeastern Honshu), New Zealand, Australia (New South Wales), Torres Island.

Habitat and Biology : A little-known, easily recognized, bizarre dogfish of the uppermost continental and insular slopes, and probably the outer continental-insular shelves, of the western Pacific at depths of 360 to 494 m depth on or near the bottom. Ovoviviparous, number of young per litter 10 in one female (5 per uterus), size at birth not known. Food not known, but probably mostly bottom fishes with some invertebrates as in well-known species of Squalus. The tremendous, mandarin-like nasal barbels of this shark suggest that it may have enhanced sensory capacities in its barbels (presumably chemosensory), and that it trails them over the substrate like sturgeon or catfish to locate prey.



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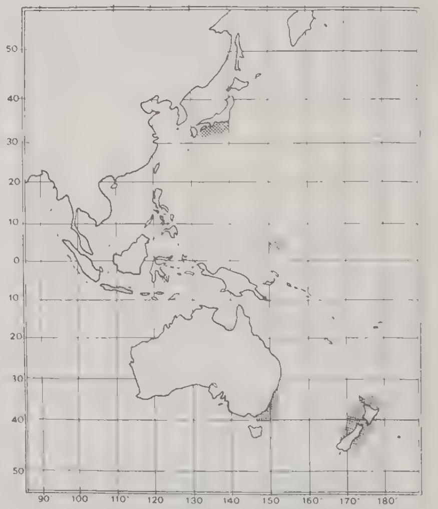
Size : Maximum 122 cm, adults males about 86 cm, females mature above 92 to 108 cm reaching at least 122 cm.

Interest to Fisheries : None at present. Garrick & Paul (1971a) note that this dogfish has a liver with a high squalene content but no Vitamin A, as in other deepwater sharks. In comparison the inshore Squalus acanthias has a high Vitamin A content and very low squalene, and the outer shelf S. "blainvillei" (= S. cf. mitsukurii) has a lower Vitamin A content and somewhat higher squalene content.

Literature : Tanaka (1912); Herre (1935, 1936); Garrick & Paul (1971a); Bass (1979).



Dalatias Rafinesque, 1810

SQUAL Dal

Genus : Dalatias Rafinesque, 1810, Caratt.gen.sp.anim.piant.Sicilia, Palermo, Pt. 1:10.

Type Species : Dalatias sparophagus Rafinesque, 1810, by subsequent designation of Jordan, Tanaka & Snyder (1913:22), apparently equals Squalus licha Bonnaterre, 1788. See discussion below.

Synonymy : Subgenus Scymnus Cuvier, 1817 (Genus Squalus Linnaeus, 1758, not Scymnus Kugelmann, 1794 in Class Insecta); ? Genus Scimnus S.D.W., 1837; ? Genus Scymnium Cuvier, 1838; Genus Scymnorhinus Bonaparte, 1846; Genus Borborodes Gistel, 1848; Genus Pseudoscymnus Herre, 1935; Genus Scymnorhynus Nobre, 1935 (error or emendation); Genus Barborodes Bigelow & Schroeder, 1948 (error).

Diagnostic Features : Anterior nasal flaps short, not expanded into barbels; snout broadly conical, rounded, and short, length much less than distance from mouth to pectoral origins and about 1/4 of head length; gill openings moderately broad and about equally wide; lips very thick, fringed or pleated, not suctorial; teeth very different in upper and lower jaws, uppers small, with narrow, hooked, needle-shaped cusps and no cusplets, lowers very large, bladelike, interlocked, with broad, erect, triangular cusps, small distal blades, and serrated edges; tooth rows 16 to 21/17 to 20. Both dorsal fins without spines; first dorsal origin somewhat behind free rear tips of pectoral fins, first dorsal insertion well anterior to pelvic origins, closer to pectoral bases than pelvics; second dorsal origin about over middle of pelvic bases; second dorsal fin only slightly larger than first, its base less than 1.5 times first dorsal base; pectoral fins with short, broadly rounded free rear tips, not broadly lobate or acute and elongated; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe very short or virtually absent, subterminal notch well-developed. No precaudal pits or lateral keels on caudal peduncle. Dermal denticles with low flat, ridged, unicuspid crowns, not pedicellate. Cloaca without a luminous gland. Colour greyish to black or blackish brown, sometimes violet with black spots.

Remarks : A number of writers have used the genus Scymnorhinus for Squalus licha Bonnaterre, 1788 on the grounds that the synonymy of Dalatias sparophagus with S. licha is invalid because D. sparophagus is a species dubium and indeterminate. I follow common recent usage (Bigelow & Schroeder, 1948, 1957; Garrick, 1960a; Bass, d'Aubrey & Kistnasamy, 1976) in retaining Dalatias, at least until the International Commission on Zoological Nomenclature rules on the problem.

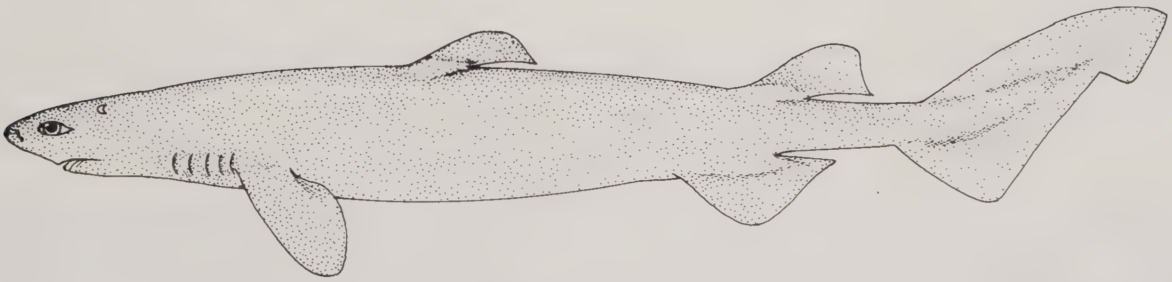
Dalatias licha (Bonnaterre, 1788)

SQUAL Dal 1

Squalus licha Bonnaterre, 1788, Tabl.encyclop.méthod.trois règ.nat., Ichthyol., Paris:12. Holotype : Lost. Type Locality : "Le cap Bretan".

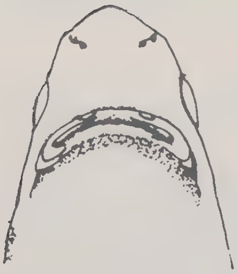
Synonymy : Squalus americanus Gmelin, 1789; ? Dalatias sparophagus Rafinesque, 1809; Squalus nicaensis Risso, 1810; Scymnus vulgaris Cloquet, 1822 (1823 ?); Squalus scymnus Voigt, in Cuvier, 1832; ? Scymnus aquitanensis de la Pylaie, 1835; Scymnorhinus phillippsi Whitley, 1931; Pseudoscymnus boshuensis Herre, 1935; Scymnorhinus brevipinnis J.L.B. Smith, 1936; Dalatias tachiensis Shen & Ting, 1972.

FAO Names : En - Kitefin shark; Fr - Squale liche; Sp - Carocho.



Field Marks : A moderate-sized, short-and blunt-snouted shark with two almost equal-sized spineless dorsal fins, no anal fin, papillose thick lips, small slender-cusped upper teeth and very large lower teeth with erect triangular serrated cusps and distal blades, first dorsal fin on back with its origin behind the pectoral rear tips and its base closer to the pectoral base than the pelvics, and caudal fin with the ventral lobe not expanded.

Diagnostic Features : See genus.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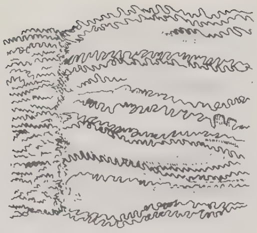
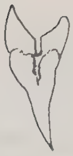
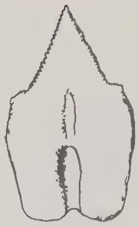
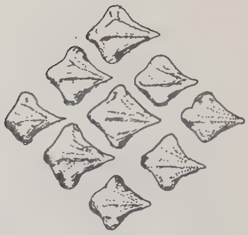
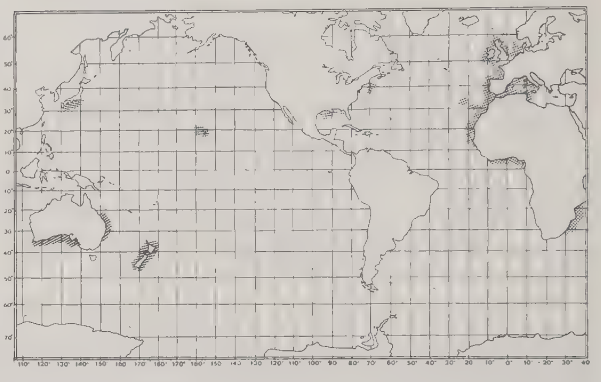

fringed lips


upper tooth


lower tooth


dermal denticles



Geographical Distribution : Western North Atlantic: Georges Bank, northern Gulf of Mexico. Eastern Atlantic: North Sea, Scotland, and Irish Atlantic Slope to Morocco, western Mediterranean, Madeira, Azores, West Sahara to Senegal, Ivory Coast to Cameroon. Western Indian Ocean: South Africa, southern Mozambique. Western Pacific: Japan, Australia (southern Queensland, Great Australian Bight, South West Australia), New Zealand. Central Pacific: Hawaiian Islands.

Habitat and Biology : A common but sporadically distributed deepwater, warm-temperate and tropical shark of the outer continental and insular shelves and slopes from 37 to at least 1800 m depth, commonest below 200 m. It occurs most frequently on or near the bottom but readily ranges well off the substrate. Its large oily liver allows it to attain neutral buoyancy, so it can move or hover above the bottom without the necessity of utilizing dynamic lift from fins and body. Catch records in the Mediterranean Sea suggest that it is primarily a solitary shark, not found in schools. Development is ovoviviparous, with litters of 10 to 16 young.

This shark is a powerful and versatile deepsea predator, equipped with huge serrated teeth and compact, heavy jaws of enormous power. It feeds primarily on deepwater bony fishes, including deepwater smelt (Argentinidae), viperfishes, scaly dragonfishes, barracudinas, greeneyes, lanternfishes, gonostomatids, cod, ling, whiting and other gadids, hake, grenadiers, deepwater scorpionfishes, bonito, gempylids, epigonids, and chaunacid anglers, but also skates, catsharks (*Galeus*), spiny dogfish (*Squalus*, *Etmopterus* and *Centrophorus*), squid, octopi, amphipods, isopods, shrimp and lobsters, and even polychaetes and siphonophores. The recorded diet is fairly representative of the bottom and midwater fauna where it occurs, but the presence of fast-swimming epipelagic fishes such as bonito may indicate either scavaging or some unknown means of ambushing or otherwise overcoming such prey. Often chunks of large fish are found in the stomach of this shark, as well as small whole fish. In the western Mediterranean bony fishes are a staple primary fare throughout the year. Sharks are consumed more commonly as secondary prey in spring and winter, but crustaceans become more important in the summer and cephalopods in the fall. Adults sharks eat more crustaceans and sharks and less cephalopods than young. For some reason male *Dalatias* have full stomachs more commonly than females.

Size : Maximum to at least 159 cm, possibly to 182 cm, males adult between 77 to 121 cm, females between 117 to 159 cm, size at birth about 30 cm.

Interest to Fisheries : In the Eastern Atlantic captured in bottom trawls and utilized for fishmeal and leather. Off Japan it is fished for human consumption and for the squalene content of its liver oil.

Literature : Bigelow & Schroeder (1948, 1957); Maurin & Bonnet (1970); Bass, d'Aubrey & Kistnasamy (1976); Wheeler (1978); Cadenat & Blache (1982); Matallanas (1982); L.R. Taylor (pers. comm.).

Remarks : The synonymy for this species follow Bigelow & Schroeder (1948, 1957) and Bass, d'Aubrey & Kistnasamy (1976). Recently Shen & Ting (1972) described a new species, *Dalatias tachiensis*, from the Western Pacific, but its distinguishing dental, dermal denticle, and labial characters are apparently juvenile ones of its 48 cm holotype, duplicated in a 49 cm immature male specimen of *D. licha* from the Eastern Atlantic examined by me (BMNH 1952.2.18.2 from Porcupine Bank). Hence *D. tachiensis* is synonymized with *D. licha*.

Deania Jordan & Snyder, 1902

SQUAL Dean

Genus : Deania Jordan & Snyder, 1902, Proc.U.S.Nat.Mus., 25(1279):80.

Type Species : Deania eglantina Jordan & Snyder, 1902, by monotypy, equals Acanthidium calceum Lowe, 1839.

Synonymy : Genus Nasisqualus Smith & Radcliffe, 1912; Genus Deaniops Whitley, 1932.

Field Marks : Extremely long snout, pitchfork-shaped denticles, large grooved spines on dorsals, no anal fin, subterminal notch on caudal fin.

Diagnostic Features : Anterior nasal flaps short, not expanded into barbels; snout greatly elongated, spatulate, flattened, length over half head length and greater than distance from mouth to pectoral origins; gill openings moderately broad and about equally wide; lips thin, not fringed or pleated, not suctorial; teeth somewhat different in upper and lower jaws, uppers smaller, with narrow, erect to semi-oblique cusps, short blades, no cusplets, and high, broad roots, semi-bladelike, lower teeth larger, broad, bladelike with semierect to oblique narrow cusps, short blades, interlocked roots, and smooth edges; tooth rows 26 to 33/26 to 31. Both dorsal fins with grooved spines, the second very large, strongly curved, and elongated, the first short but strong; first dorsal origin varying from about over rear ends of pectoral bases to over pectoral free rear tips, first dorsal insertion well in front of pelvic origins and about midway between pectoral and pelvic bases; second dorsal origin about over middle of pelvic bases; second dorsal fin about as large or slightly larger than first, its base subequal to about 2/3 length of first dorsal base; pectoral fins with narrowly rounded or angular free rear tips, not broadly lobate or acutely attenuate; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe very short, subterminal notch well-developed. No precaudal pits or lateral keels on caudal peduncle; midventral keel variably present or absent. Dermal denticles with high pedicels, tricuspidate and triridged, erect crowns, and stellate bases, resembling tiny pitchforks. Cloaca without a luminous gland. Colour dark grey or brown.

Remarks : Arrangement of this genus follows Bigelow & Schroeder (1957), Bass, d'Aubrey & Kistnasamy (1976), and Cadenat & Blache (1981).

Key to Species :

1a. A subcaudal keel on the lower surface of the caudal peduncle .... **D. profundorum**

1b. No subcaudal keel on the lower caudal peduncle

  2a. First dorsal fin rather high, angular, and short, distance from its spine origin to free rear tip about 2/3 of distance from free rear tlip to origin of second dorsal spine .... **D. quadrispinosum**

  2b. First dorsal fin rather low, rounded, and long, distance from its spine origin to its free rear tip greater than distance from free rear tip to origin of second dorsal spine

    3a. Lateral trunk denticles moderately large, crown length about 0.5 mm. Colour usually grey-brown .... **D. calcea**

    3b. Lateral trunk denticles very large, crown length about 1 mm. Colour usually blackish .... **D. hystricosa**

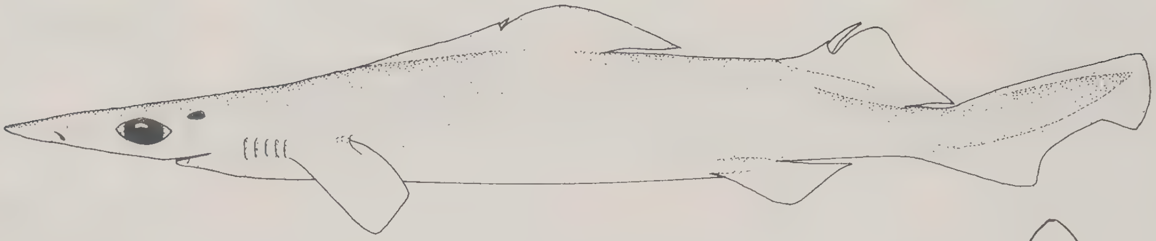
Deania calcea (Lowe, 1839)

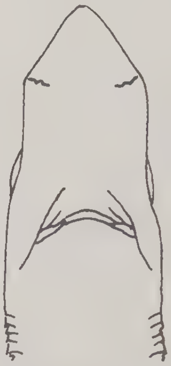
SQUAL Dean 1

Acanthidium calceum Lowe, 1839, Trans.Zool.Soc.Lond., 3(1):19. Holotype : British Museum (Natural History). Type Locality : Madeira.

Synonymy : Centrophorus crepidalbus Bocage & Capello, 1868; Deania eglantina Jordan & Snyder, 1902; Acanthidium rostratum Garman, 1906; Acanthidium aciculatum Garman, 1906; Centrophorus kaikourae Whitley, 1934.

FAO Names : En - Birdbeak dogfish; Fr - Squale savate; Sp - Tollo pajarito.



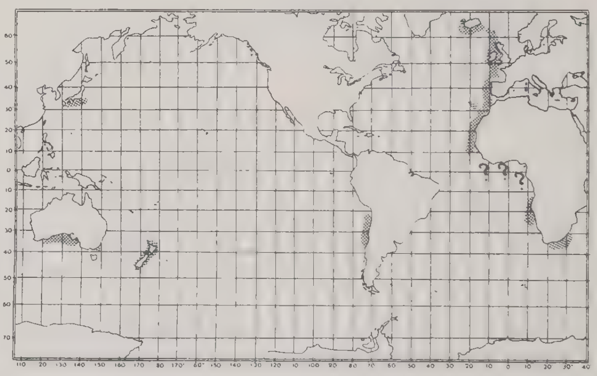


underside of head

Field Marks : Extremely long snout, no anal fin, grooved dorsal fin spines, compressed cutting teeth in both jaws, pitchfork-shaped small denticles, no subcaudal keel on caudal peduncle, extremely long, low, first dorsal fin.

Diagnostic Features : First dorsal fin long and low, origin over bases of pectoral fins; distance from origin of first dorsal spine to first dorsal rear tip much greater than distance from free rear tip to second dorsal spine. No subcaudal keel on underside of caudal peduncle. Denticles fairly small, crown length about 0.5 mm long. Colour grey-brown. Maximum size about 111 cm.

Geographical Distribution : Eastern North Atlantic: Iceland along Atlantic slope to Faeroe Island, Madeira, Mauritania, possibly Senegal, Namibia. Western Indian Ocean: South Africa. Western Pacific: Japan (southern Honshu), southern Australia, New Zealand. Eastern Pacific: Central Chile.



Habitat and Biology : A common but little-known deepwater dogfish of the outer continental and insular shelves and upper slopes from 73 to 1450 m depth, on or near the bottom or well above it. Ovoviviparous, possibly with litters of 6 to 12, as these were the number of fertilized eggs found in the uteri of some specimens. Eats hatchetfish, scaly dragonfishes (Stomiatidae) and shrimps.

Size : Maximum total length about 111 cm, adults males 70 to 91 cm, females 70 to 111 cm, size at birth above 30 cm.

Interest to Fisheries : Caught in pelagic trawls in the eastern Atlantic. Caught by line in the western Pacific, for squalene-rich liver oil.

Literature : Bigelow & Schroeder (1957); Cadenat (1957); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981).

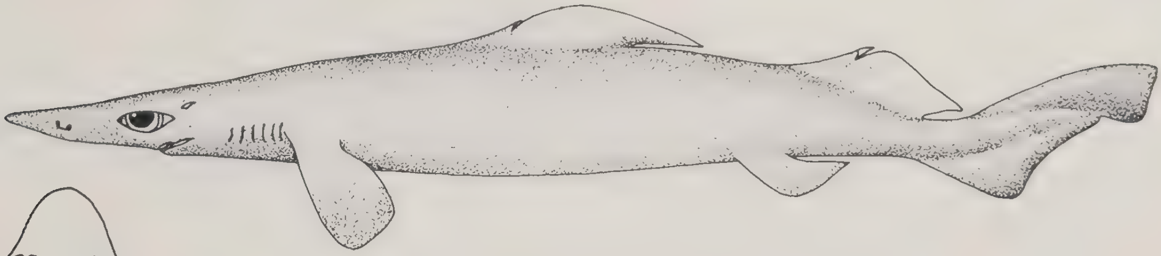
Deania histricosa Garman, 1906

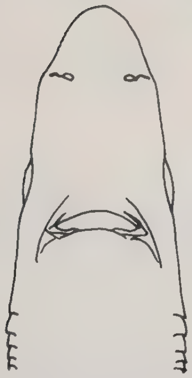
SQUAL Dean 3

Acanthidium histricosum Garman, 1906, Bull.Mus.Comp.Zool.Harvard, 46(11):203-208. Holotype : Museum of Comparative Zoology, Harvard, apparently lost. Type Locality : Japan.

Synonymy : ? Deania mauli Cadenat & Blache, 1981.

FAO Names : En - Rough longnose dogfish; Fr - Squale-savate rude; Sp - Tollo raspa.





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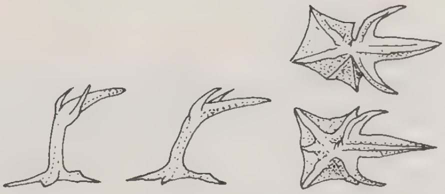
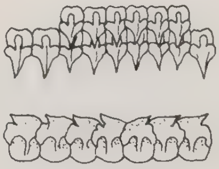


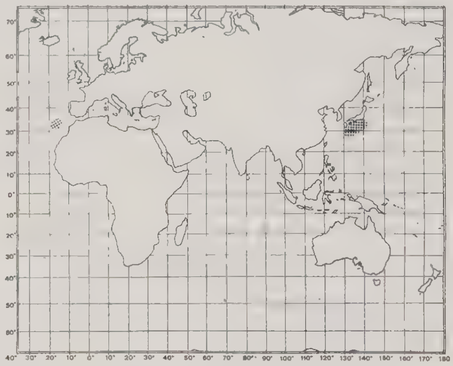
dermal denticles



upper and
lower teeth

Field Marks : Extremely long snout, no anal fin, grooved dorsal fin spines, compressed cutting teeth in both jaws, large pitchfork-shaped denticles, no subcaudal keel on underside of caudal peduncle.

Diagnostic Features : First dorsal fin long and low, origin over bases of pectoral fins; distance from origin of first dorsal spine to first dorsal rear tip much greater than distance from free rear tip to second dorsal spine. No subcaudal keel on underside of caudal peduncle. Denticles very large, crowns length about 1 mm long. Colour blackish brown. Maximum size about 109 cm.



Geographical Distribution : Eastern North Atlantic: Madeira. Western North Pacific: Japan.

Habitat and Biology : A little-known benthic and probably epibenthic dogfish of the insular slope of Madeira and Japan, caught at depths of 600 to 1000 m. Ovoviviparous, litter sizes not known but a female with 12 large eggs suggests moderate-sized litters. Food not recorded.

Size : Maximum total length 109 cm; adults males reported 84 cm, females immature at 80 and 96 cm and adults at 106 to 109 cm.

Interest to Fisheries : Minimal, caught with deepset vertical longlines (espada lines) off Madeira, utilization not reported.

Literature : Garman (1906, 1913); Bigelow & Schroeder (1957); Cadenat & Blache (1981).

Remarks : This species has been synonymized with Deania calcea (as its synonym D. eglantina) by Bigelow & Schroeder (1957). Recently Cadenat & Blache (1981) named a new species, D. mauli, from Madeira, which chiefly differs from D. calcea in its much larger denticles and perhaps a darker coloration. However, reference to Garman (1906, 1913) shows that D. mauli agrees in its large denticles and coloration with D. histricosa and apparently has no significant differences from it. The two species are tentatively synonymized here and recognized as separate from D. calcea under the older name histricosa.

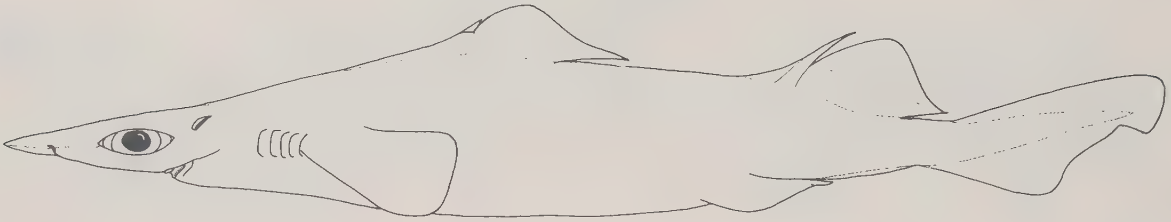
Deania profundorum (Smith & Radcliffe, 1912)

SQUAL Dean 4

Nasisqualus profundorum Smith & Radcliffe, 1912, Proc.U.S.Nat.Museum, 41(1877):681, fig. 3, pl. 53. Holotype : US National Museum of Natural History, USNM-70258, 430 mm adult male. Type Locality : Philippine Islands, between Leyte and Mindanao, 9°24'N, 125°12'E, 1347 m.

Synonymy : Acanthidium natalense Gilchrist, 1922; Deania elegans Springer, 1959; Deania cremouxi Cadenat, 1960.

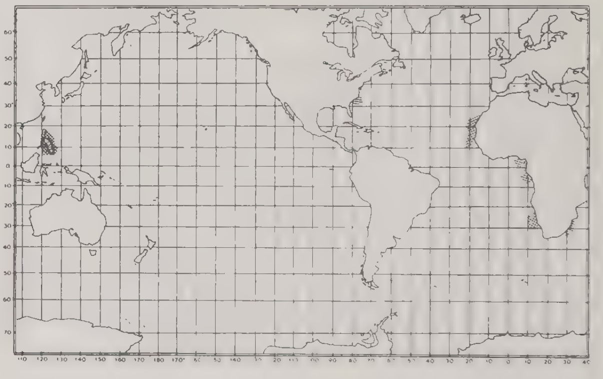
FAO Names : En - Arrowhead dogfish; Fr - Squale-savate lutin; Sp - Tollo flecha.



Field Marks : Extremely long snout, no anal fin, grooved dorsal fin spines, compressed cutting teeth in both jaws, small, pitchfork-shaped denticles, subcaudal keel on underside of caudal peduncle, first dorsal fin short and high.

Diagnostic Features : First dorsal fin short and high, origin over inner margins of pectoral fins; distance from origin of first dorsal spine to first dorsal free rear tip slightly greater than distance from free rear tip to second dorsal spine. A subcaudal keel present on underside of caudal peduncle. Denticles small, crown length about 25 mm long. Colour dark grey or grey brown. Size smaller than other Deania, maximum total length about 76 cm.

Geographical Distribution : Western North Atlantic: North Carolina. Eastern Atlantic: West Sahara to Senegal, Nigeria, Gabon to Zaire, Namibia. Western Indian Ocean: South Africa. Western Pacific: The Philippines.



Habitat and Biology : A little-known dogfish of the upper continental and insular slopes, found on or near the bottom at depths from 275 to 1785 m. Ovoviviparous, probable number of young 5 to 7 judging from uterine fertilized eggs. Eats small benthic and midwater bony fishes, including lanternfish, squid and crustaceans.

Size : Maximum total length about 76 cm, adults males 43 to 67 cm, adults females 70 to 76 cm, size at birth above 31 cm.

Interest to Fisheries : None ?

Literature : Smith & Radcliffe (1912); Bigelow & Schroeder (1957); Springer (1959); Cadenat (1960); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981).

Remarks : This account follows Bass, d'Aubrey & Kistnasamy (1976) in including Deania cremouxi in tentative synonymy of D. profundorum, along with D. natalense and D. elegans. However, Cadenat & Blache (1981) considered it a 'form' of D. calcea.

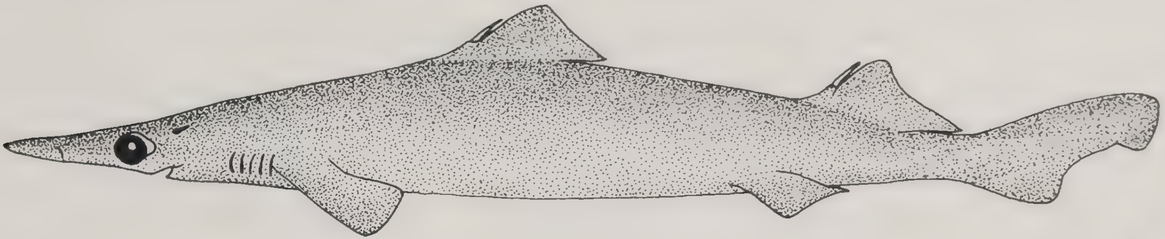
Deania quadrispinosum (McCulloch, 1915)

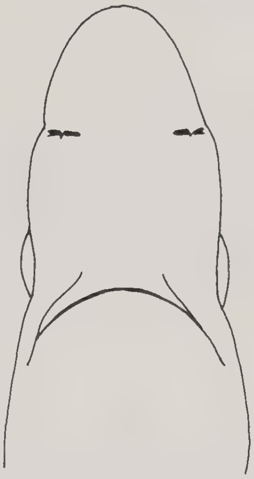
SQUAL Dean 2

Acanthidium quadrispinosum McCulloch, 1915, Zool.Result.Fish.Exp.Endeavour, Commonw. Australia, Dept. Trade Cust., 3:100, pl. 14, figs 5-8. Holotype : ? Number, 683 mm male. Type Locality : South of Gabo Island, Victoria, Australia.

Synonymy : None.

FAO Names : En - Longsnout dogfish; Fr - Squale-savate à long nez; Sp - Tollo trompalarga.





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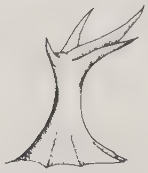
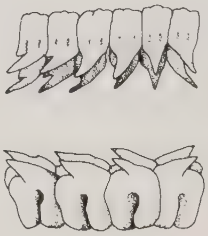


dermal denticle



upper and lower teeth

Field Marks : Extremely long snout, no anal fin, grooved dorsal fin spines, compressed cutting teeth in both jaws, moderately large, pitchfork-shaped denticles, no subcaudal keel on underside of caudal peduncle, first dorsal fin short and high.

Diagnostic Features : First dorsal fin short and high, origin over inner margins of pectoral fins; distance from origin of first dorsal spine to first dorsal rear tip much less than distance from free rear tip to second dorsal spine. No subcaudal keel on underside of caudal peduncle. Denticles moderately large, crown length about 75 mm long. Colour dark brown. Maximum size about 114 cm.

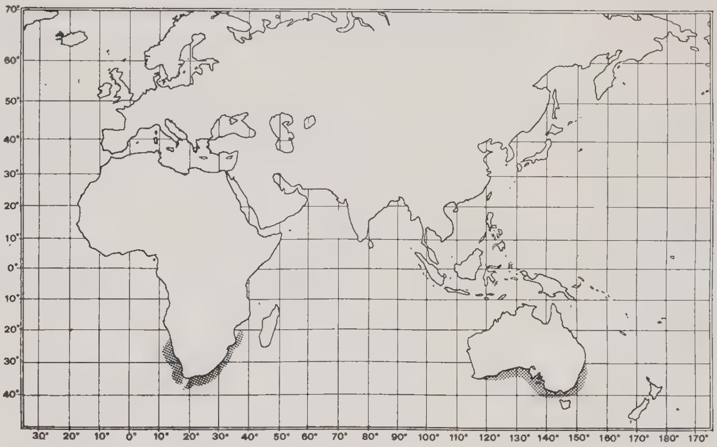
Geographical Distribution : Eastern South Atlantic and western Indian Ocean: Namibia, South Africa, southern Mozambique. Western Pacific: Australia (South Australia, Victoria, New South Wales).

Habitat and Biology : A little-known deepwater dogfish of the outer continental shelves and upper slopes at 150 to 732 m depth. Eats bony fishes.

Size : Maximum total length about 114 cm, adult female 110 cm.

Interest to Fisheries : None.

Literature : Whitley (1940); Bass, d'Aubrey & Kistnasamy (1976).



Etmopterus Rafinesque, 1810

SQUAL Etmo

Genus : Etmopterus Rafinesque, 1810, Caratt.gen.sp.anim.piant., Sicilia, Palermo, Pt. 1:14.

Type Species : Etmopterus aculeatus Rafinesque, 1810, by monotypy, equals Squalus spinax Linnaeus, 1758.

Synonymy : Subgenus Spinax Cuvier, 1817 (Cloquet, 1816 ?); Genus Centrina Lowe, 1833 (not Centrina Cuvier, 1817 = Oxynotus Rafinesque, 1810); Genus Acanthidium Lowe, 1839; Genus Acanthidim Sollas, 1906 (error).

Field Marks : Moderate snout, upper teeth with cusp and cusplets, lower teeth bladelike, no anal fin, second dorsal fin and fin spine larger than first dorsal fin and spine.

Diagnostic Features: Anterior nasal flaps short, not expanded into barbels; snout short to moderately elongated, flattened or subconical, length half head length or less and subequal to or less than distance from mouth to pectoral origins; gill openings small to moderately broad and about equally wide; lips thin, not fringed or pleated, not suctorial; teeth strongly different in upper and lower jaws, uppers small, with narrow erect cusps and mesial and distal cusplets, not bladelike, lowers larger, bladelike, interlocked, with a short, narrow, oblique cusp and distal blade; tooth rows 18 to 38/24 to 52. Both dorsal fins with grooved spines, the second very large, strongly curved, and elongated, the first short but strong; first dorsal origin varying from over inner margins of pectorals to well posterior to pectoral free rear tips, insertion well anterior to pelvic origins and varying from about equidistant between pectoral and pelvic bases or closer to pectorals; second dorsal fin considerably larger than first, its base up to twice length of first dorsal base; pectoral fins with broadly rounded free rear tips, not broadly lobate or acutely attenuate; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe hardly differentiated or short, subterminal notch well-developed. No precaudal pits or lateral keels on caudal peduncle. Dermal denticles either with stout to slender pedicels and acute, erect, narrow, ridged thornlike crowns or very flat and blocklike, with truncated crowns. Cloaca without a luminous gland. Colour variable, from blackish to tan, often with prominent dark markings on underside of head and caudal peduncle.

Remarks: The arrangement of species follows Bigelow & Schroeder (1957) in many particulars. Several of the species are poorly known and are of uncertain validity and the present arrangement must be considered as highly tentative. Several new species await description, including a long-snouted *pusillus*-like lanternshark from near Japan (Nakaya, 1982), at least one new species from the western Atlantic (S. Springer, pers. comm.), and possibly one or more from the eastern Pacific. *Etmopterus paessleri* Lönnberg, 1907 is generally placed in this genus, but consideration of its characters led me to place it in tentative synonymy of *Centroscymnus macracanthus* (see Remarks under that species). The vernacular name 'lantern shark' indicates the minute photophores of these sharks, also found in the closely related *Centroscyllium*.

Key to Species:

1a. Denticles with low, flat, concave, sessile crowns atop low bases .... **E. pusillus**

1b. Denticles with erect, thornlike, cuspidate crowns, more or less elevated from bases.

  2a. Two rows of conspicuous, enlarged denticles on flanks above pectoral fins .... **E. sentosus**

  2b. No enlarged denticles on flanks above pectoral fins

    3a. Upper teeth with 4 or 5 pairs of cusplets on each side .... **E. decacuspidatus**

    3b. Upper teeth usually with 3 or fewer pairs of cusplets on each side

      4a. Denticles on sides of body in regular lines

        5a. Colour dark above and below, no conspicuous flanks markings

          6a. Distance from snout tip to first dorsal spine about as long as spine to upper caudal origin. Caudal fin short, much less than head .... **E. villosus**

          6b. Distance from snout tip to first dorsal spine much less than distance from spine to upper caudal origin. Caudal fin longer, greater than head .... **E. bullisi**

        5b. Colour light above and conspicuously dark on the underside, with prominent black flank markings

          7a. Black flank marking without a long anterior branch extending in front of pelvic fins .... **E. granulosus**

          7b. Black flank marking with a long anterior branching in front of pelvic fins

            8a. Body very slim. Tail very long, distance from pelvic insertions to lower caudal origin equal to head. Posterior branch of flank marking very narrow and greatly expanded, longer than anterior branch .... **E. brachyurus**

            8b. Body rather stout. Tail short, distance from pelvic insertions to lower caudal origin much less than head. Posterior branch of flank marking rather broad and short, shorter than anterior branch .... **E. lucifer**

      4b. Denticles on sides of body randomly arranged, not in regular lines

9a. Pectoral fins and to a lesser extent other fins with a broad fringe of exposed ceratotrichia .... E. schultzi

9b. Pectoral fins either unfringed or narrowly or irregularly fringed with ceratotrichia

  10a. Distance from pelvic insertions to lower caudal origin at least 2/3 and often as long as distance between pectoral and pelvic bases

    11a. Distance from pectoral origins to pelvic origins not longer than head length .... E. polli

    11b. Distance from pectoral origins to pelvic origins longer than head length

      12a. Lateral trunk denticles with low, conical cusps. Underside of snout naked .... E. virens

      12b. Lateral trunk denticles with long, slender cusps. Underside of snout scaled

        13a. Black markings on sides of tail and underside of head distinct. Prespiracular head about as long as distance from spiracles to pectoral insertions. Interdorsal space about as long as snout tip to pectoral insertions .... E. hillianus

        13b. Dark markings on body indistinct. Prespiracular head about as long as distance from spiracles to pectoral origins. Interdorsal space much less than snout tip to pectoral origins .... E. gracilispinis

  10b. Distance from pelvic insertions to lower caudal origin only about half as long as distance between pectoral and pelvic bases

    14a. Interdorsal space longer than distance from snout tip to pectoral insertions. Distance from second dorsal insertion to upper caudal origin about a third as long as interdorsal space .... E. baxteri

    14b. Interdorsal space about equal to head length. Distance from second dorsal insertion to upper caudal origin about half length of interdorsal space

      15a. Head width about equal to preoral length. Gill openings short, a third eye length or less. Conspicuous black flank markings present .... E. spinax

      15b. Head width nearly 1.5 times preoral length. Gill openings broad, over a third of eye length. No conspicuous flank markings

        16a. Dermal denticles on sides with fairly thick cusps .... E. princeps

        16b. Dermal denticles on sides with slender, bristle-like cusps .... E. unicolor

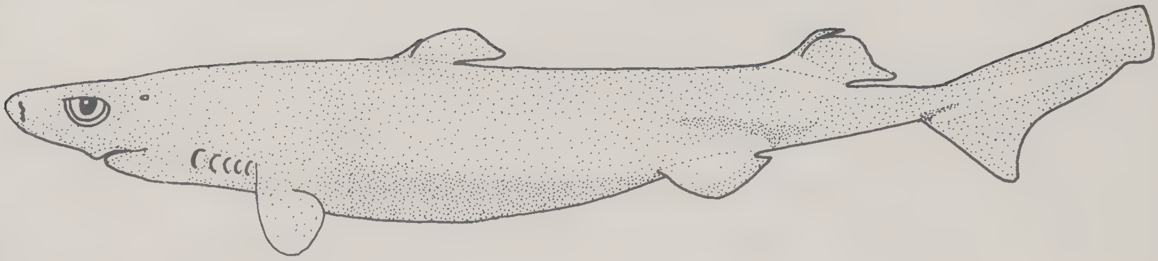
Etmopterus baxteri Garrick, 1957

SQUAL Etmo 5

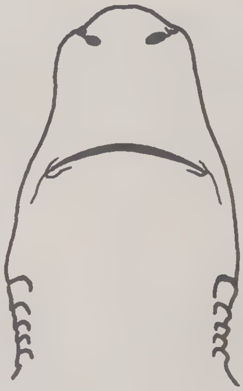
Etmopterus baxteri Garrick, 1957, Bull.Mus.Comp.Zool.Harv.Coll., 116(3):172, fig. 1-2. Holotype : Dominion Museum (National Museum of New Zealand), DM 1950, 742 mm adult female. Type Locality : South of Kaikoura, New Zealand, 915 m depth.

Synonymy : None.

FAO Names : En - New Zealand lanternshark; Fr - Sagre porte-feu; Sp - Tollo lucero.



Field Marks : See diagnostic features.



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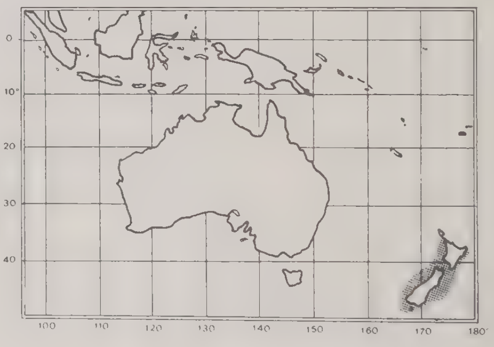
Diagnostic Features : A stout-bodied lanternshark with a short tail, distance from pelvic insertions to lower caudal origins somewhat less than prebranchial length, about twice in distance between pectoral and pelvic bases and nearly twice in interdorsal space; distance between pectoral and pelvic bases long in adults, about 1.5 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal midbase. Head width slightly less than prebranchial length; prespiracular length slightly greater than distance from spiracles to pectoral origins; gill openings moderately wide, much greater than spiracle width and about half eye length. Origin of first dorsal fin well behind free rear tips of pectoral fins, first dorsal base considerably closer to pectoral bases than pelvics; interdorsal space long, about as long as distance from snout tip to pectoral insertions; second dorsal fin much larger than first and about twice its area; distance between second dorsal base and upper caudal origin slightly over 3 times in interdorsal space; caudal fin short and broad, length of dorsal caudal margin about equal to distance from snout tip to pectoral origins. Lateral trunk denticles with hooked conical crowns, not arranged in regular longitudinal rows; snout probably covered with denticles; no greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour dark above and below, with vague blackish markings on underside of snout and abdomen, with an elongated narrow black mark running above and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.

Geographical Distribution : Western South Pacific: New Zealand.



Habitat and Biology : A little-known lanternshark from the upper insular slopes of New Zealand, found on or near the bottom at depths of 878 to 1427 m.

Size : Maximum total length 75 cm, males adult at 66 cm, females at 75 cm.

Interest to Fisheries : None at present.

Literature : Garrick (1957); Bigelow & Schroeder (1957).

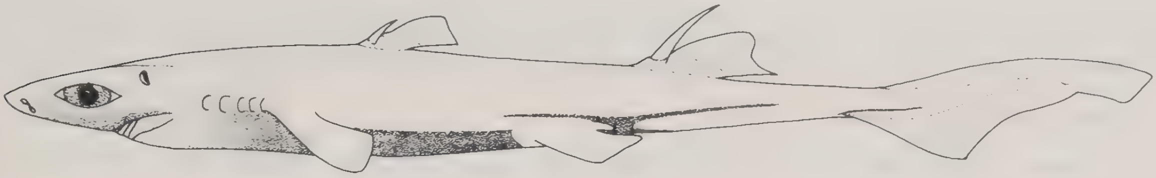
Etmopterus brachyurus Smith & Radcliffe, 1912

SQUAL Etmo 6

Etmopterus brachyurus Smith & Radcliffe, 1912, Bull.U.S.Nat.Mus., 41:677-685, fig. **Holotype :** U.S. National Museum of Natural History, USNM 70257, 227+ mm adult male. **Type Locality :** Jolo Island, Philippines, 481 m depth.

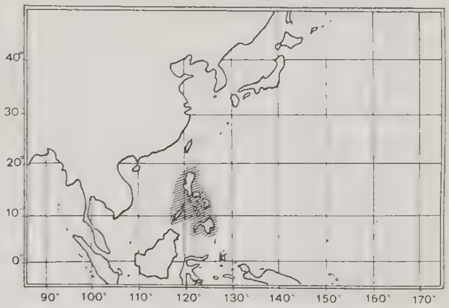
Synonymy : None.

FAO Names : En - Shorttail lanternshark; Fr - Sagre porte-feu à queue courte; Sp - Tollo lucero mocho.



Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, conspicuous lines of denticles on body, slender body, prominent ventral and very long tail markings.

Diagnostic Features : A very slender-bodied lanternshark with a long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to pectoral origins, about 1.2 times distance between pectoral and pelvic bases, and slightly greater than interdorsal space; distance between pectoral and pelvic bases short in adults, less than head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal insertion, first dorsal base considerably closer to pectoral bases than pelvics. Head width about equal to preoral snout. Prespiracular length slightly greater than distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth with 3 pairs of cusplets. Origin of first dorsal fin above inner margins of pectoral fins. Interdorsal space short, slightly less than distance from snout tip to pectoral origins; second dorsal fin much larger than first and about twice its area; distance between second dorsal base and upper caudal origin about 1.4 in interdorsal space; caudal fin long and slender, length of dorsal caudal margin about equal to distance from snout tip to pectoral origins. Lateral trunk denticles with slender, hooked conical crowns, arranged in prominent regular longitudinal rows on dorsal surface of head, sides of body and tail that give the shark an etched, engraved appearance; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour brown above, with underside of snout and abdomen abruptly black, with an extremely narrow elongated black mark running above, in front and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Western Pacific: Philippines, and probably elsewhere in the western Pacific.

Habitat and Biology : A little-known lanternshark, found near the bottom in the Philippine Islands at 481 m depth.

Size : Maximum total length over 22.7 cm (male holotype with damaged caudal fin, probably at least 24 cm long with complete tail).

Interest to Fisheries : None at present.

Literature : Smith & Radcliffe (1912); Fowler (1941); Bigelow & Schroeder (1957).

Remarks : This lanternshark is close to E. lucifer but has usually been recognized as a valid species on the primary character of its shorter caudal fin (Fowler, 1941; Bigelow & Schroeder, 1957). However, examination and radiography of the holotype convinced me that this is based on an anomaly. Apparently this specimen had its caudal fin damaged in life; the terminal lobe was apparently severed (perhaps by a predator), and the caudal fin was partially regenerated distal to its truncated vertebral column to form a false terminal lobe. This species may be a synonym of E. lucifer but is tentatively recognized here. As indicated by the illustrations of this species and E. lucifer (both made from holotypes, with the caudal fin of E. brachyurus restored from other Philippine examples of the species), E. brachyurus may be a slenderer shark with a longer interdorsal space, shorter head, smaller second dorsal fin, and longer posterior branch on its black tail marking. It is uncertain at present if all these differences are valid. If so, some records of E. lucifer may be based on E. brachyurus.

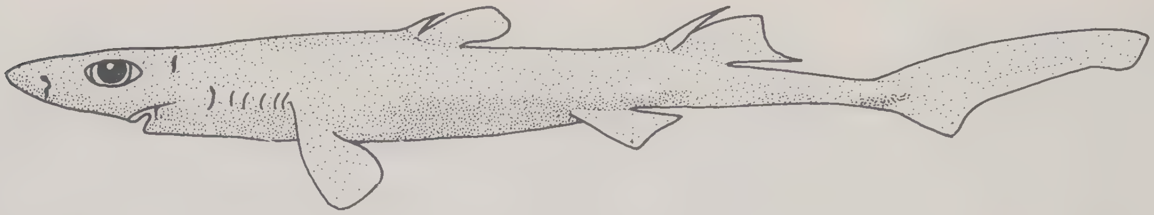
Etmopterus bullisi Bigelow & Schroeder, 1957

SQUAL Etmo 7

Etmopterus bullisi Bigelow & Schroeder, 1957, Bull.Mus.Comp.Zool.Harv.Coll., 117(1):50, fig. 5A-D, pl. 2. Holotype : US National Museum of Natural History USNM-158186, 196 mm female. Type Locality : Northeast coast of Florida, USA 29°48'N, 80°09'W, about 366 m depth.

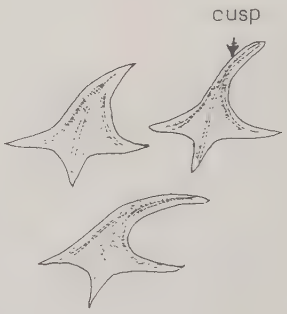
Synonymy : None.

FAO Names : En - Lined lanternshark; Fr - Sagre chien; Sp - Tollo lucero rayado.



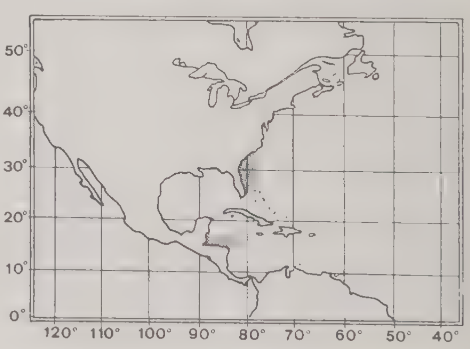
Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, conspicuous longitudinal rows of denticles, slender body, dark uniform colour with inconspicuous markings.

Diagnostic Features : A slender-bodied lanternshark with a long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to first gill openings, slightly less than distance between pectoral and pelvic bases, and slightly greater than interdorsal space; prespiracular length 1.6 times distance from spiracles to pectoral origins; distance between pectoral and pelvic bases short in adults, about 0.7 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal rear tip. Gill openings very short, about as wide as spiracle, 1/3 eye length of less. Origin of first dorsal fin over inner margins of pectoral fins, first dorsal base considerably closer to pectoral bases than pelvics; interdorsal space very short, about as long as distance from snout tip to spiracles; second dorsal fin much larger than first but less than twice its area; distance between second dorsal base and upper caudal origin about 1.3 in interdorsal space; caudal fin long and slender, length of dorsal caudal margin about equal to head length. Lateral trunk denticles with slender, hooked conical crowns, wide-spaced and arranged in regular longitudinal rows on sides and dorsal surface of head, body, and tail; snout largely covered with denticles; no greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour dark grey above, with underside of snout and abdomen abruptly black; with an elongated narrow black mark running above and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



dermal denticles

Geographical Distribution : Western North Atlantic: North Carolina to northern Florida (USA), Honduras.



Habitat and Biology : A little-known lanternshark, from the western Atlantic continental slopes on or near the bottom at about 366 m depth.

Size : Maximum total length recorded 23 cm for an immature male, adults size unknown.

Interest to Fisheries : None.

Literature : Bigelow & Schroeder (1957); Cadenat & Blache (1981).

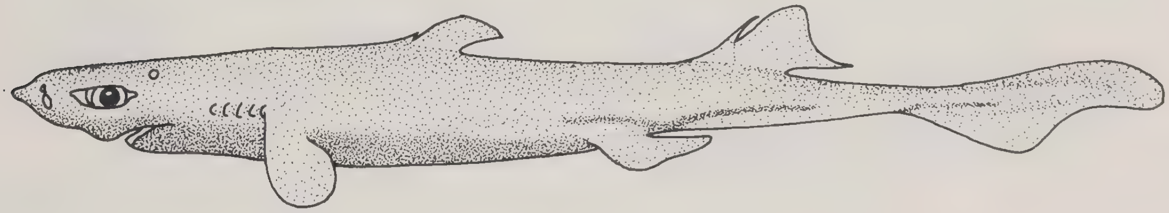
Etmopterus decacuspidatus Chan, 1966

SQUAL Etmo 8

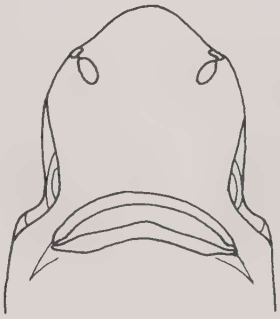
Etmopterus decacuspidatus Chan, 1966, J.Zool., Proc.Zool.Soc.London, 148:220, fig. 1, Pl. 1a. Holotype : British Museum (Natural History), BMNH 1965.8.11.7, 292 mm adult male. Type Locality : South of Cape Bastion, Hainan Island, China, 16°40.5'N, 109°49.9'E, 512 to 692 m.

Synonymy : None.

FAO Names : En - Combtoothed lanternshark; Fr - Sagre filtre; Sp - Tollo lucero peine.



Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and upper teeth with a cusp and 4 or 5 pairs of cusplets.



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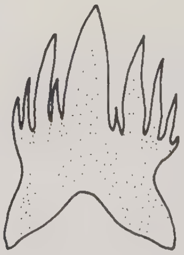
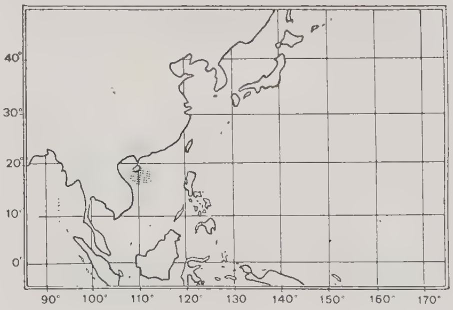


tooth

Diagnostic Features : A moderately slender-bodied lanternshark with a long tail, distance from pelvic insertions to ventral caudal origin about as long as head, about 1.2 times in distance between pectoral and pelvic bases, and 1.2 times interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.2 times head length; distance from snout tip to first dorsal spine slightly greater than distance from first dorsal spine to second dorsal insertion. Head width about 1.4 times preoral snout; prespiracular length about 1.4 times distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth with 4 or 5 pairs of cusplets. Origin of first dorsal fin slightly behind free rear tips of pectoral fins, first dorsal base considerably closer to pectoral bases than pelvics; interdorsal space short, about as long as distance from snout tip to third gill slit; second dorsal fin much larger than first and about twice its area; distance between second dorsal base and upper caudal origin about 1.5 in interdorsal space; caudal fin moderately long and fairly broad, length of dorsal caudal margin almost equal to head length. Lateral trunk denticles with very slender, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour brown above, with underside of snout and abdomen abruptly black, with an elongated narrow black mark running above, in front, and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Western North Pacific: China, south of Hainan Island.

Habitat and Biology : A little-known lanternshark taken off Hainan Island, China, on or near the bottom in 512 to 692 m.

Size : The only known specimen is an adult male at 29 cm total length.

Interest to Fisheries : None at present.

Literature : Chan (1966).

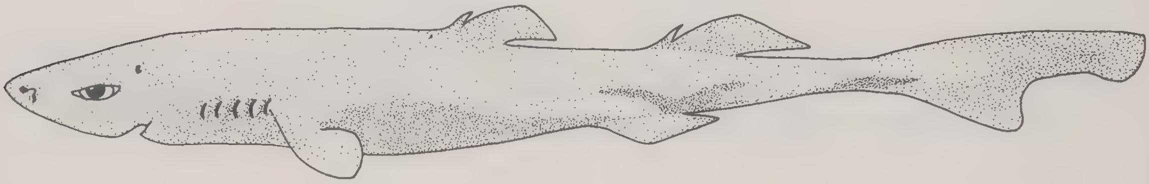
Etmopterus gracilispinis Krefft, 1968

SQUAL Etmo 9

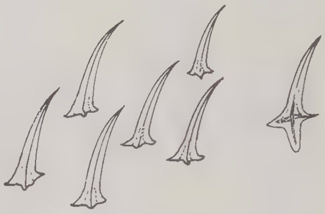
Etmopterus gracilispinis Krefft, 1968, *Arch.Fischereiwiss.*, 19(1):3, figs 2, 3a, 4, 5a. Holotype : Institut für Seefischerei, Hamburg, ISH 1051/66, 255 mm maturing male. Type Locality : Continental slope of Uruguay, western south Atlantic, 34°01'S, 51°20'W, 600 m depth.

Synonymy : None.

FAO Names : En - Broadbanded lanternshark; Fr - Sagre rubané; Sp - Tollo lucero bandoneado.



Diagnostic Features : A moderately stout-bodied lanternshark with a short tail, distance from pelvic insertions to ventral caudal origin somewhat less than tip of snout to first gill openings, 1.4 to 1.6 times in distance between pectoral and pelvic bases, and about equal to interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.3 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to upper caudal origin. Head width about equal to preoral snout. Prespiracular length about 1.5 times distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin well behind free rear tips of pectoral fins, first dorsal base somewhat closer to pelvic bases than pectorals; interdorsal space short, about as long as distance from snout tip to spiracles; second dorsal fin much larger than first and about twice its area; distance between second dorsal base and upper caudal origin about equal to interdorsal space; caudal fin moderately long and slender, length of dorsal caudal margin about equal to head length. Lateral trunk denticles with very slender, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour blackish-brown above, with underside of snout and abdomen grading to black, with an inconspicuous elongated but broad black mark running above and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



dermal denticles

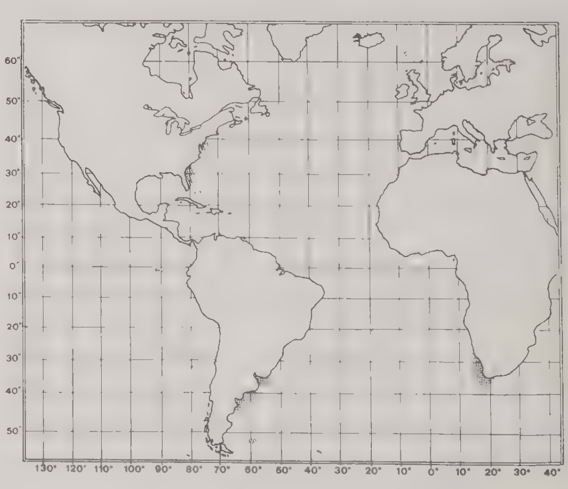
Geographical Distribution : Western Atlantic: Virginia, Florida (USA); Uruguay and Argentina. Eastern Atlantic: South Africa.

Habitat and Biology : A lanternshark from the outer continental shelves and upper slopes, on or near bottom at depths of 100 to 1000 m; also epipelagic and mesopelagic at depths of 70 to 480 m over water 2240 m deep off Argentina.

Size : Maximum total length about 33 cm, males mature at or above 26 cm, females mature at 33 cm.

Interest to Fisheries : None at present.

Literature : Krefft (1968, 1980); Schwartz & Burgess (1975); Cadenat & Blache (1981).



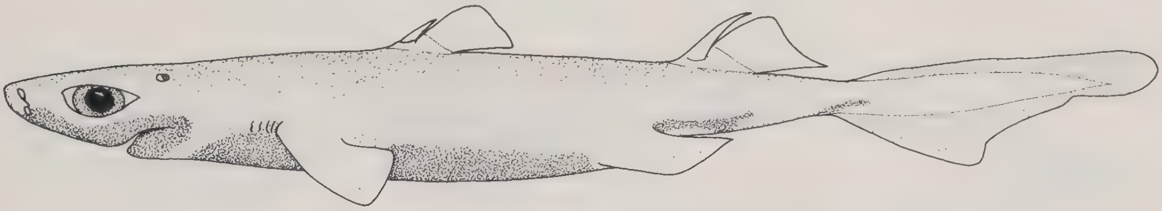
Etmopterus granulosus (Günther, 1880)

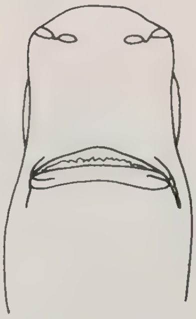
SQUAL Etmo 10

Spinax granulosus Günther, 1880, *Rep.Sci.Res.Voy.H.M.S. Challenger*, 1873-76, Zool., 1(6):19, pl. 2C. Holotype : British Museum (Natural History), BMNH 1879.5.14.460, 256 mm adolescent male. Type Locality : Off Chile, 220 m depth.

Synonymy : None.

FAO Names : En - Southern lanternshark; Fr - Sagre long nez; Sp - Tollo negro narigón.





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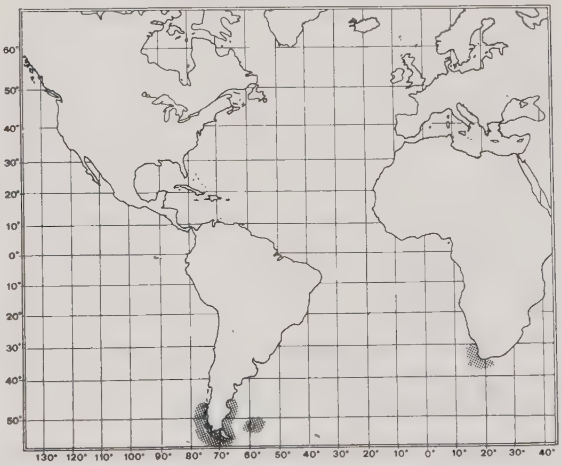
Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, stocky body, conspicuous lines of denticles on body, conspicuous black markings on underside of body and tail, with tail marking short and not extending far posteriorly.

Diagnostic Features : A moderately stout-bodies lanternshark with a short tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to spiracles, 1.6 times in distance between pectoral and pelvic bases, and 1.3 in interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about equal to head length; distance from snout tip to first dorsal spine to second dorsal insertion. Head width about 1.3 times preoral snout; prespiracular length about 1.3 times distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, less than 1/3 eye length; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin slightly in front of free rear tips of pectoral fins, first dorsal base considerably closer to pectoral bases than pelvics; interdorsal space short, somewhat less than distance from snout tip to first gill slits; second drosal fin much larger than first; distance between second dorsal base and upper caudal origin about 2.5 in interdorsal space; caudal fin moderately long but broad, length of dorsal caudal margin about equal to distance from snout tip to pectoral midbases. Lateral trunk denticles with moderately stout, hooked conical crowns, wide-spaced and in random order on the head above the pectorals but forming regular longitudinal rows on trunk and tail; snout mostly bare of denticles, except for lateral patches; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour brown above, with underside of snout and abdomen abruptly black, with a short, broad black mark running above and slightly behind pelvic inner margins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Western South Atlantic: Southern Argentina, Falkland Islands/Malvinas, Straits of Magellan. Eastern South Atlantic: Cape of Good Hope, South Africa. Eastern South Pacific: Southern Chile.

Habitat and Biology : A little-known lanternshark of the outermost continental shelves and upper slopes at depths of 220 to 637 m. It is an unusual southern hemisphere distribution, off southern South America, the Falklands/ Malvinas Islands, and South Africa.

Size : Males adolescent at 26 to 38 cm total length, maximum probably larger.

Interest to Fisheries : None at present.

Literature : Bigelow & Schroeder (1957); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981).

Remarks : The systematic position of this species in its genus has been obscured by an error of observation on the nature of its dermal denticles dating from its original description and perpetuated in the systematic literature. I examined the holotype of *E. granulosus* and did not find the granular denticles supposed to characterize the species, but rather slender-cusped conical denticles partially arranged in longitudinal rows as in *E. lucifer*. The species is, however, easily distinguished from *E. lucifer* and other species with denticles in longitudinal rows. The above illustration is based on the holotype.

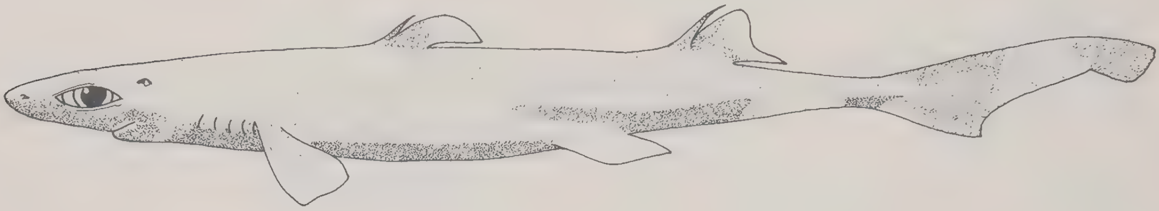
Etmopterus hillianus (Poey, 1861)

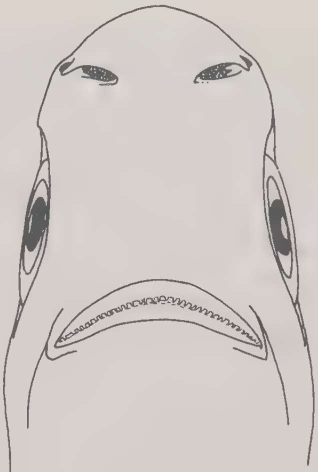
SQUAL Etmo 11

Spinax hillianus Poey, 1861, Memorias Hist.Nat.Cuba, 2:340, pl. 19, figs 13-14. **Holotype :** Museum of Comparative Zoology, Harvard, MCZ-1025, 269 mm female, presumably adult. **Type Locality :** Off Havana, Cuba.

Synonymy : None.

FAO Names : En - Caribbean lanternshark; Fr - Sagre antillais; Sp - Tollo lucero antillano.





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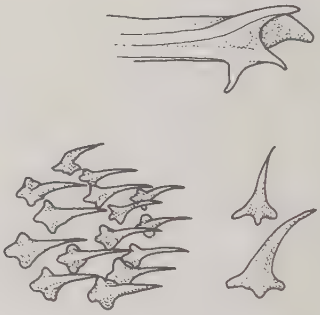
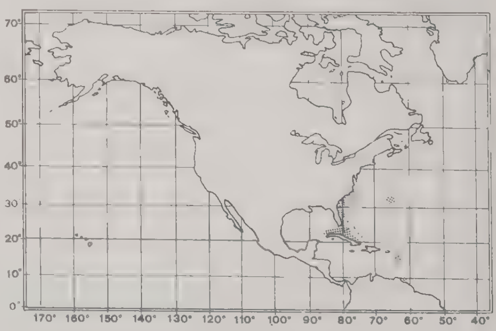


dermal denticles

Diagnostic Features : A moderately stout-bodied lanternshark with a moderately long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to second gill openings, slightly less than 1.3 times in distance between pectoral and pelvic bases, and about equal to interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.2 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal insertion. Head width about equal to preoral snout; prespiracular length about 1.5 times distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin just behind free rear tips of pectoral fins, first dorsal base considerably closer to pectoral bases than pelvics; interdorsal space short, about as long as distance from snout tip to third gill slits; second dorsal fin much larger than first but less than twice its area; distance between second dorsal base and upper caudal origin about 2 in interdorsal space; caudal fin moderately long, lnegth of dorsal caudal margin about equal to head length. Lateral trunk denticles with slender, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour grey or dark brown above, with underside of snout and abdomen abruptly black, with an elongated broad black mark running above and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Western North Atlantic: Virginia to southern Florida (USA), Cuba, Bermuda, St. Kitts.

Habitat and Biology : A lanternshark of the upper continental and insular slopes, on or near bottom, at 380 to 717 m depth. Ovoviviparous, number of young 4 to 5.

Size : Maximum total length about 50 cm; males mature at about 25 to 27 cm; females mature at about 30 cm; size at birth about 9 cm.

Interest to Fisheries : Slight, caught with hook-and-line off Cuba and probably not very important; method of utilization unknown.

Literature : Bigelow & Schroeder (1948, 1957); Schwartz & Burgess (1975); Cadenat & Blache (1981).

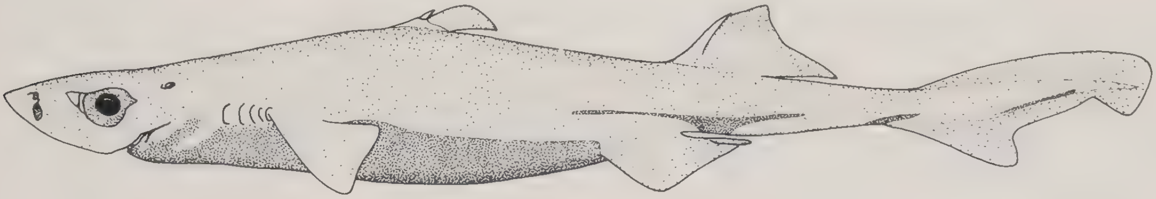
Etmopterus lucifer Jordan & Snyder, 1902

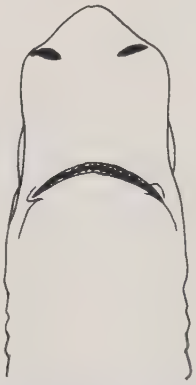
SQUAL Etmo 12

Etmopterus lucifer Jordan & Snyder, 1902, Proc.U.S.Nat.Mus., 25(1279):79, fig. 1. Holotype : Stanford University Natural History Museum, SU-6863, 282 mm adult male. Type Locality : Off Misaki, Japan.

Synonymy : Acanthidium molleri Whitley, 1930; Etmopterus abernathyi Garrick, 1957.

FAO Names : En - Blackbelly lanternshark; Fr - Sagre lucifer; Sp - Tollo lucero diablo.





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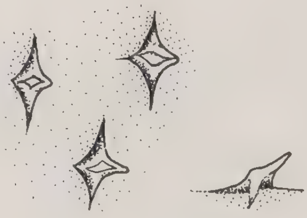
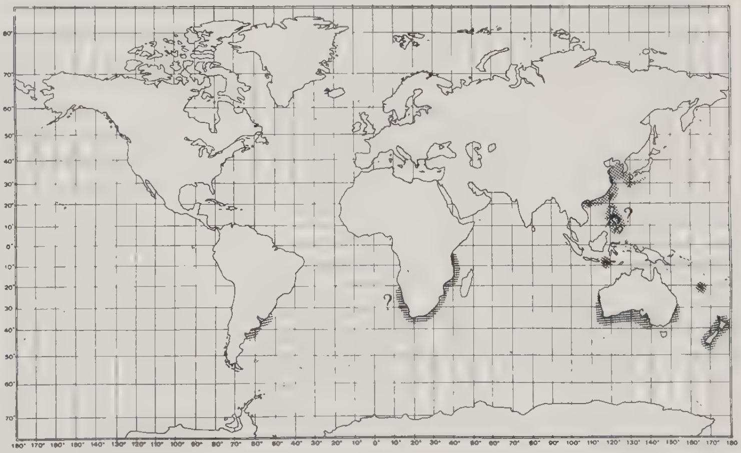


dermal denticles

Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, stocky body, long tail, short interdorsal space, longitudinal rows of denticles on body, very large second dorsal fin, prominent black markings on underside of body and sides of tail.

Diagnostic Features : A fairly stout-bodied lanternshark with a moderately long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to first gill openings, slightly less than 1.5 times in distance between pectoral and pelvic bases, and slightly less than interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about equal to head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal rear tip. Head width about equal to preoral snout; prespiracular length about 1.8 times distance from spiracles to pectoral origins; gill openings moderately long, considerably wider than spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin slightly behind free rear tips of pectoral fins, first dorsal base considerably closer to pectoral bases than pelvics; interdorsal space short, about as long as head; second dorsal fin much larger than first and over twice its area; distance between second dorsal base and upper caudal origin about 1.5 in interdorsal space; caudal fin moderately long, length of dorsal caudal margin slightly less than head length. Lateral trunk denticles with slender, hooked conical crowns, arranged in regular longitudinal rows on entire dorsolateral surface from snout tip to sides of caudal fin, giving shark and engraved appearance; snout partially naked on anterolateral surfaces; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely naked but not highly fringed with naked ceratotrichia. Colour brown above, with underside of snout and abdomen abruptly black, with an elongated narrow black mark running above, ahead and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Western South Atlantic: Uruguay, Argentina. Eastern South Atlantic: ? Namibia. Western Indian Ocean: Cape of Good Hope, South Africa, to Mozambique and Tanzania. Western Pacific: Japan (southeastern Honshu), Yellow Sea, to Taiwan Island, South China Sea, Bali (Indonesia), ? Philippines, Australia (New South Wales, South and Western Australia), New Caledonia, New Zealand.

Habitat and Biology : A wide-ranging lanternshark, found on the outer continental and insular shelves and upper slopes on or near the bottom, at depths of 183 to 823 m. Off Natal, South Africa, adult males are much more numerous than females. Development presumably ovoviviparous. Eats mostly squid and small bony fishes, including lanternfish, and also shrimp.

Size : Maximum total length about 42 cm; males adult at 29 to 42 cm; females adult at 34 cm or more.

Interest to Fisheries : Unknown at present.

Literature : Bigelow & Schroeder (1957); Krefft (1968); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981).

Remarks : The illustration is based on the holotype. It is uncertain if all records of E. lucifer are based on this species or include records of E. brachyurus.

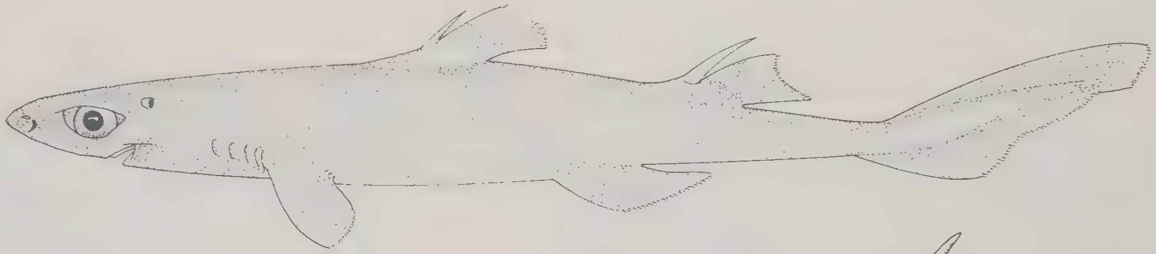
Etmopterus polli Bigelow, Schroeder & Springer, 1953

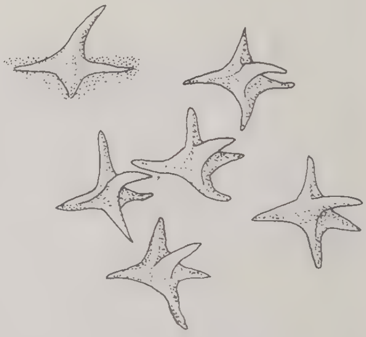
SQUAL Etmo 1

Etmopterus polli Bigelow, Schroeder & Springer, 1953, Bull.Mus.Comp.Zool.Harvard, 109(3):241, fig. 7. Holotype : Museum of Comparative Zoology, Harvard, MCZ 38001, adult or adolescent male, 197 mm. Type Locality : Northern Angola, 6°08'S, 11°24'E, 350 to 380 m depth.

Synonymy : None.

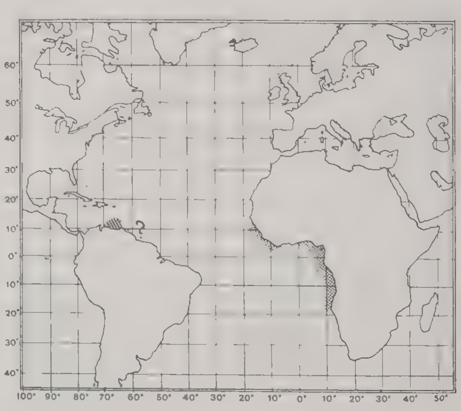
FAO Names : En - African lanternshark; Fr - Sagre à menton lisse; Sp - Tollo lucero africano.





dermal denticles

Diagnostic Features : A moderately stout-bodied lanternshark with a fairly long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to first gill openings, about equal to distance between pectoral and pelvic bases, and 1.3 times interdorsal space; distance between pectoral and pelvic bases moderately long in adults, slightly less than head length; distance from snout tip to first dorsal spine equal or somewhat greater than distance from first dorsal spine to second dorsal rear tip. Head width about equal to preoral snout; prespiracular length slightly greater than distance from spiracles to pectoral origins; gill openings short, slightly wider than spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin opposite free rear tips of pectoral fins, dorsal fin base much closer to pectoral bases than pelvics; interdorsal space short, about as long as distance from snout tip to spiracles; second dorsal fin about as large or slightly larger than first; distance between second dorsal base and upper caudal origin about equal to interdorsal space; caudal fin moderately long, length of dorsal caudal margin about equal to head length. Lateral trunk denticles with slender, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour dark grey above, with underside of snout and abdomen blackish, with an elongated broad black mark running above, ahead and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Eastern Atlantic: Guinea to Ivory Coast, Nigeria to Angola. ? Western Central Atlantic: Venezuela.

Habitat and Biology : A lanternshark of the upper continental slopes, on or near bottom at depths of 300 to 1000 m.

Size : Maximum total length about 24 cm; adult males to 23 cm, females to 24 cm. Reports of this species from 30 to 80 cm unverified and possibly based in part on other species of Etmopterus.

Interest to Fisheries : In the eastern Atlantic this species (and possibly others reported under its name) are captured offshore in bottom trawls, fixed bottom nets and on hook-and-line gear, and utilized dried salted for human consumption and for fishmeal.

Literature : Poll (1950); Bigelow, Schroeder & Springer (1953); Bigelow & Schroeder (1957); Cadenat & Blache (1981).

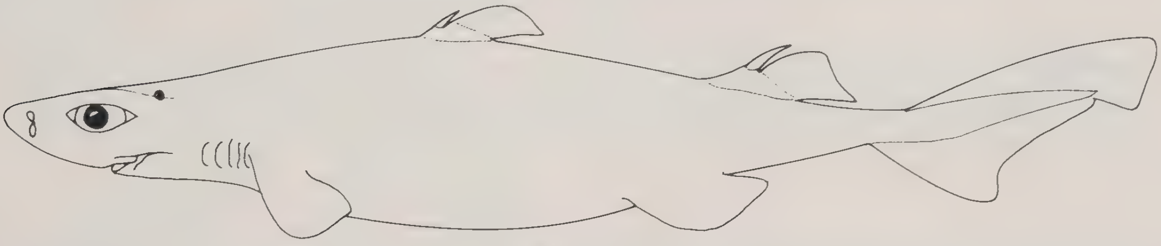
Etmopterus princeps Collett, 1904

SQUAL Etmo 4

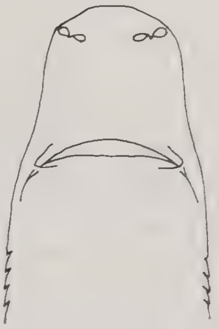
Etmopterus princeps Collett, 1904, Christiania Vidensk.Selsk.Forhand., 1904(9):3. Holotype : Four syntypes, Zoologisk Museum, Oslo, ZMO J64 (2 specimens), ZMO J65 (1 specimen); Zoologisk Museum Universitetet i Bergen, UBNM 3496 (1 specimen); lectotype apparently not designated. Type Locality : Faroe Channel, Faroe Bank; from 750 to 1200 m depth.

Synonymy : None.

FAO Names : En - Great lanternshark; Fr - Sagre rude; Sp - Tollo lucero raspa.



Diagnostic Features : A stout-bodied lanternshark with a short tail, distance from pelvic insertions to ventral caudal origin slightly greater or less than tip of snout to spiracles, slightly over 2 times in distance between pectoral and pelvic bases, and about 1.5 times in interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.4 times head length; distance from snout tip to first dorsal spine about equal to or greater than distance from first dorsal spine to second dorsal insertion. Head width nearly twice preoral snout; prespiracular length about 1.6 times distance from spiracles to pectoral origins; gill openings very long, about as wide as spiracle, 1/2 eye length; upper teeth generally less than 3 pairs of cusplets. Origin of first dorsal fin well behind free rear tips of pectoral fins, dorsal fin base somewhat closer to pectoral bases than pelvics; interdorsal space short, slightly less than or greater than head; second dorsal fin much larger than first but less than twice its area; distance between second dorsal base and upper caudal origin about 2 in interdorsal space; caudal fin moderately long and very broad, length of dorsal caudal margin about equal to distance from snout tip to pectoral insertions. Lateral trunk denticles with fairly stout, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour blackish above and below, no conspicuous dark markings.



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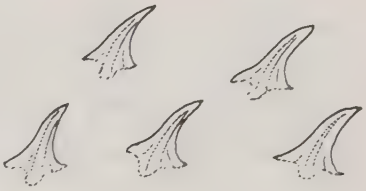
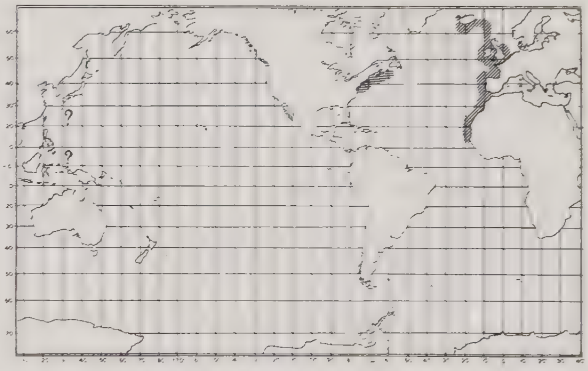


dermal denticles

Geographical Distribution : Western North Atlantic: Nova Scotia (Canada) to New Jersey (USA). Eastern North Atlantic: Southern Iceland along Atlantic slope to Faeroes, Hebrides, UK, English Channel, Bay of Biscay and Gibraltar, Mauritania. ? Western Pacific: Kyushu-Palau Ridge.



Habitat and Biology : A lanternshark of the continental slopes, on or near bottom at depths of 567 to 2213 m.

Size : Maximum total length about 75 cm, males mature at 55 cm.

Interest to Fisheries : Possibly fished in the eastern Atlantic but details not known.

Literature : Bigelow, Schroeder & Springer (1953); Bigelow & Schroeder (1957); Krefft & Stehmann (1973); Cadenat & Blache (1981); Nakaya (1982).

Remarks : Recently Nakaya (in Okamura, Amaoka & Mitani, 1982) reported this species from the Kyushu-Palau Ridge in the western Pacific. If correct, this is an immense range extension for the species.

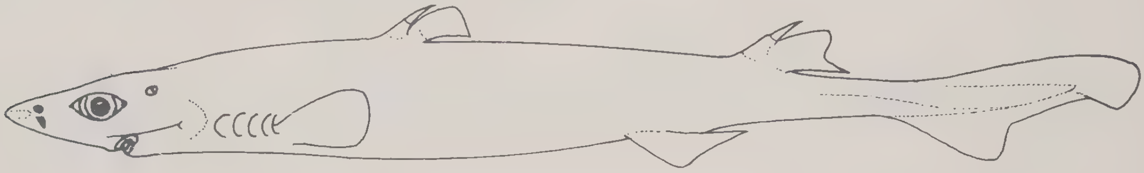
Etmopterus pusillus (Lowe, 1839)

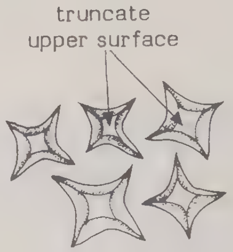
SQUAL Etmo 3

Acanthidium pusillum Lowe, 1839, Trans.Zool.Soc.Lond., 3(1):19. **Holotype :** British Museum (Natural History). **Type Locality :** Madeira, eastern Atlantic.

Synonymy : Centrina nigra Lowe, 1839; Etmopterus frontimaculatus Pietschmann, 1907.

FAO Names : En - Smooth lanternshark; Fr - Sagre nain; Sp - Tollo lucero liso.

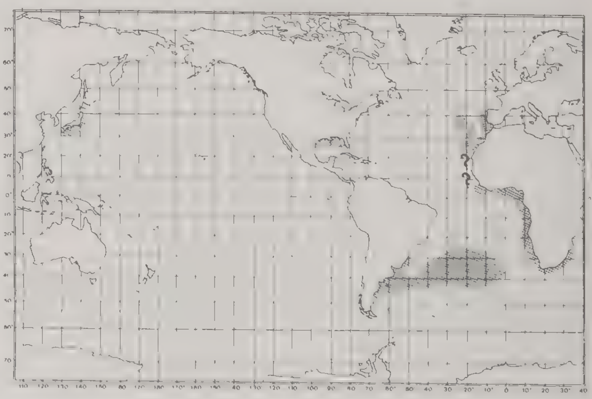




dermal denticles

Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, relatively short snout, low, truncated denticles.

Diagnostic Features : A fairly slender-bodied lanternshark with a moderately short tail, distance from pelvic insertions to ventral caudal origin somewhat greater or less than tip of snout to first gill openings, between 1.5 to 2 times in distance between pectoral and pelvic bases, and about 1.5 in interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.3 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal insertion. Head width about equal to preoral snout; prespiracular length slightly greater than distance from spiracles to pectoral origins; gill openings rather long, much wider than spiracle, 1/2 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin about opposite or slightly behind free rear tips of pectoral fins, dorsal fin base much closer to pectoral bases than pelvics; interdorsal space fairly long, nearly or quite as long as distance from snout tip to pectoral insertions; second dorsal fin much larger than first, but with area less than twice that of first; distance between second dorsal base and upper caudal origin between 2 and 3 in interdorsal space; caudal fin moderately short and broad, length of dorsal caudal margin slightly less than head length. Lateral trunk denticles with truncated, hollow, sessile, low crowns, not thorn or bristle-like, wide-spaced but not arranged in regular longitudinal rows; snout covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour blackish-brown above, with an obscure broad black mark running above, in front and behind pelvic fins.



Geographical Distribution : Western Atlantic: Northern Gulf of Mexico and southern Brazil to Argentina. Central South Atlantic (oceanic), between Argentina and South Africa. Eastern Atlantic: Portugal, Madeira, Azores, Canaries, Liberia, Ivory Coast to Gabon, Zaire, Angola and Namibia. Western Indian Ocean: South Africa. Western Pacific: Japan (southeastern Honshu).

Habitat and Biology : A lanternshark of the continental slopes, on or near bottom at a depth of 274 to 1000 m or more (possibly to 1998 m); also oceanic in the central South Atlantic, at depths between the surface and 110 to 708 m over deepwater (Krefft, 1980). Ovoviviparous. Eats fish eggs, lanternfishes, squids and other small dogfishes.

Size : Maximum total length at least 47 cm, possibly to between 50 and 100 cm; adult males 31 to 39 cm, females 38 to 47 cm.

Interest to Fisheries : In the eastern Atlantic captured in bottom trawls and in fixed bottom nets, also with line gear, and utilized dried salted for human consumption and for fishmeal.

Literature : Bigelow & Schroeder (1957); Cadenat (1957); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981).

Remarks : I follow Krefft (1968), who examined one of the syntypes of E. frontimaculatus, in placing that species in synonymy of E. pusillus. Nakaya (1982) reported an Etmopterus from the Kyushu-Palau Ridge in 340 to 370 m depth with pusillus-like denticles but with a far longer snout and more anterior first dorsal fin. This is probably a new species.

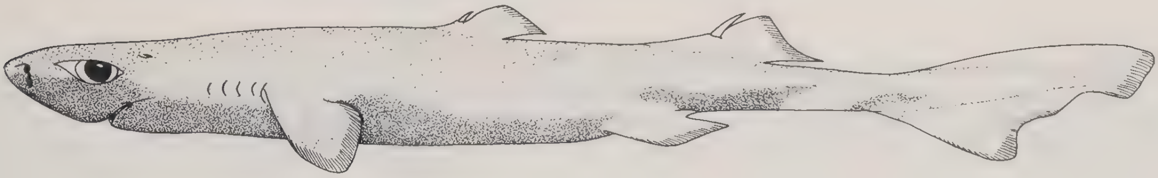
Etmopterus schultzi Bigelow, Schroeder & Springer, 1953

SQUAL Etmo 13

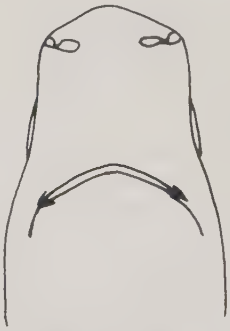
Etmopterus schultzi Bigelow, Schroeder & Springer, 1953, Bull.Mus.Comp.Zool.Harv.Univ., 109(3):252, fig. 9. Holotype : U.S. National Museum of Natural History, USNM 113381, 270 mm adult or adolescent male. Type Locality : Northern Gulf of Mexico, 29°11'N, 86°53'W, 558 m depth.

Synonymy : None.

FAO Names : En - Fringefin lanternshark; Fr - Sagre à nageoires frangées; Sp - Tollo lucero franjeado.



Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, very slender-crowned lateral trunk denticles, first dorsal fin far behind pectorals and about equidistant between pectoral and pelvic bases, no enlarged thorns on flanks, fins with highly fringed distal webbing.



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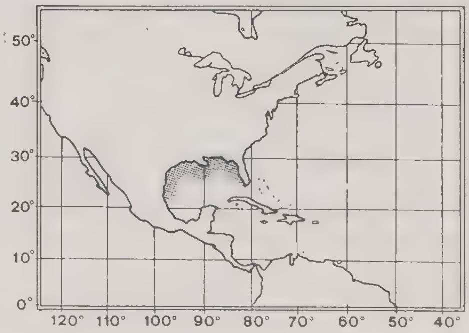
Diagnostic Features : A slender lanternshark with a moderately short tail, distance from pelvic insertions to ventral caudal origin slightly less than from tip of snout to first gill openings, 1.5 times in distance between pectoral and pelvic bases, and 0.6 times interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.1 to 1.3 times head length; distance from snout tip to first dorsal spine nearly or quite equal to distance from first dorsal spine to dorsal caudal margin. Head width about 1.4 times preoral snout; prespiracular length about equal to distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin well behind free rear tips of pectoral fins, dorsal fin base about equidistant between pectoral and pelvic bases or somewhat closer to pectorals; interdorsal space short, about as long as distance from snout tip to first gill slits or less; second dorsal fin much larger than first, about twice its area; distance between second dorsal base and upper caudal origin betewen 1 to 1.5 times in interdorsal space; caudal fin moderately long, length of dorsal caudal margin about equal to or somewhat greater than head length. Lateral trunk denticles with very slender, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins naked and with a prominently fringed margin of naked and distally separated ceratotrichia. Colour light brown above, with underside of snout and abdomen dusky grey, with an elongated narrow dusky mark running above and behind pelvic fins, and elongated black marks at caudal fin base and along its axis.

Geographical Distribution : Western North Atlantic: Northern Gulf of Mexico, Texas to Florida (USA), Mexico.



Habitat and Biology : A lanternshark from the upper continental slopes, on or near bottom at depths of 384 to 732 m.

Size : Maximum total length about 30 cm; adult males 27 cm long, females 28 to 30 cm.

Interest to Fisheries : None at present.

Literature : Bigelow, Schroeder & Springer (1953); Bigelow & Schroeder (1957); Cadenat & Blache (1981).

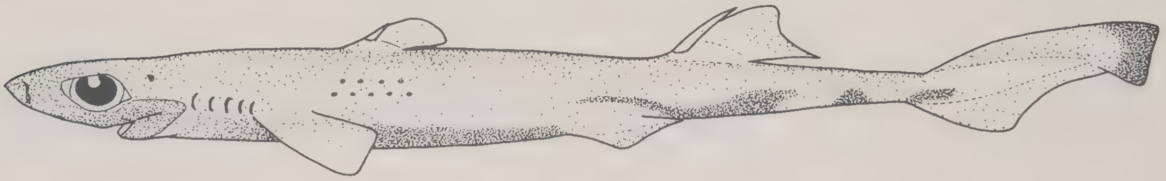
Etmopterus sentosus Bass, d'Aubrey & Kistnasamy, 1976

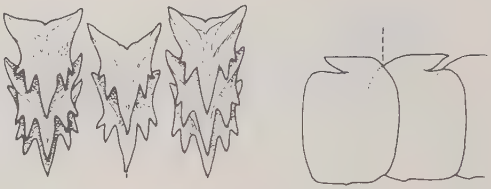
SQUAL Etmo 14

Etmopterus sentosus Bass, d'Aubrey & Kistnasamy, 1976, S.African Ass.Mar.Biol.Res., Oceanogr.Res.Inst., Invest.Rep., (45):22, figs 15, 18A. Holotype : Oceanographic Research Institute, South Africa, ORI 2369, 27 cm. Type Locality : Near Bazaruto Island, Mozambique.

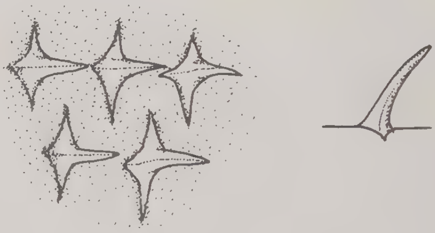
Synonymy : None.

FAO Names : En - Thorny lanternshark; Fr - Sagre épineux; Sp - Tollo lucero espinudo.





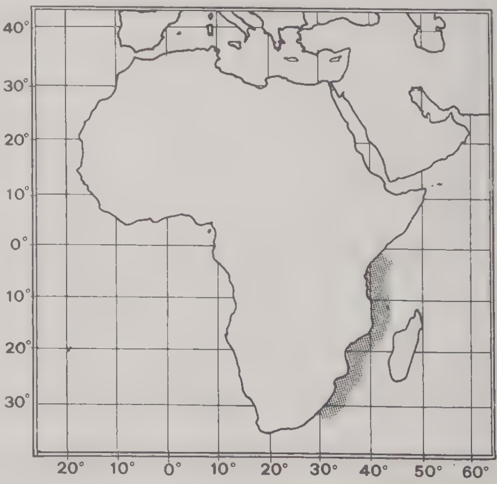
upper and lower teeth



dermal denticles

Field Marks : Two spined dorsal fins, no anal fin, blade-like unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, two longitudinal rows of enlarged denticles on flanks.

Diagnostic Features : A slender-bodied lanternshark with a moderately long tail, distance from pelvic insertions to ventral caudal origin about as long as head and about equal to distance between pectoral and pelvic bases and to interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about equal to head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal insertion. Head width slightly greater than preoral snout; prespiracular length slightly greater than distance from spiracles to pectoral origins; gill openings moderately long, wider than spiracle, about 1/3 eye length; upper teeth with 3 or 4 pairs of cusplets. Origin of first dorsal fin over inner margins of pectoral fins, dorsal fin base much closer to pectoral bases than pelvics; interdorsal space short, about equal to head length; second dorsal fin much larger than first, over twice its area; distance between second dorsal base and upper caudal origin about 1.5 in interdorsal space; caudal fin moderately long and broad, length of dorsal caudal margin about equal to head length. Lateral trunk denticles with low, short, pointed crowns with a dorsal depression, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; two rows of greatly enlarged hook-like denticles on flanks above pectoral fins. Distal margins of fins largely naked and more or less fringed with ceratotrichia. Colour greyish-black above and below, with underside of snout and abdomen inconspicuously black, an elongated broad black mark running above, in front and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



Geographical Distribution : Western Indian Ocean: South Africa, Mozambique, Kenya, Tanzania.

Habitat and Biology : A little-known lanternshark from the southeastern Indian Ocean, at depths of perhaps 200 to 500 m, at or near the bottom.

Size : Maximum total length recorded 27 cm for an immature male, size of adults unknown.

Interest to Fisheries : None.

Literature : Bass, d'Aubrey & Kistnasamy (1976); G. Bianchi-Schmidt & P.C. Heemstra (pers. comm.).

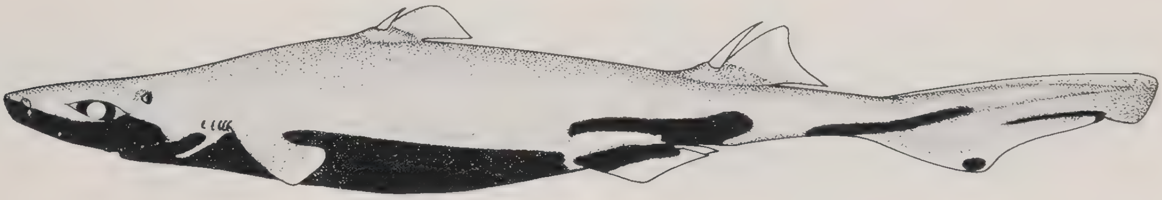
Etmopterus spinax (Linnaeus, 1758)

SQUAL Etmo 2

Squalus spinax Linnaeus, 1758, Syst.Nat., ed. 10, 1:233. Holotype : Unknown. Type Locality : "Europa".

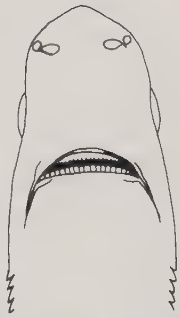
Synonymy : Squalus niger Gunnerus, 1762; Etmopterus aculeatus Rafinesque, 1810; Squalus (Acanthias) infernus Blainville, 1825; Spinax gunneri Reinhardt, 1825 (1828?); ? Spinax vitalinus de la Pylaie, 1835; Spinax linnei Malm, 1877.

FAO Names : En - Velvet belly; Fr - Sagre commun; Sp - Negrito.



Field Marks : Two spined dorsal fins, no anal fin, bladelike unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, denticles not in lines and with long slender cusps, abdomen long, tail short, black markings on underside of body and sides of tail prominent.

Diagnostic Features : A moderately stout-bodied lanternshark with a fairly long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to first gill openings, slightly less than 1.5 times in distance between pectoral and pelvic bases, and slightly less than interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.2 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal midbase. Head width about equal to preoral snout; prespiracular length slightly greater than distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin behind free rear tips of pectoral fins, dorsal fin base much closer to pectoral bases than pelvics; interdorsal space short, about as long as distance from snout tip to pectoral midbases; second dorsal fin much larger than first and about twice its area; distance between second dorsal base and upper caudal origin about 2 in interdorsal space; caudal fin moderately long, length of dorsal caudal margin about equal to distance from snout tip to pectoral insertions. Lateral trunk denticles with very slender, hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour brown above, with underside of snout and abdomen abruptly black, an elongated narrow black mark running above and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



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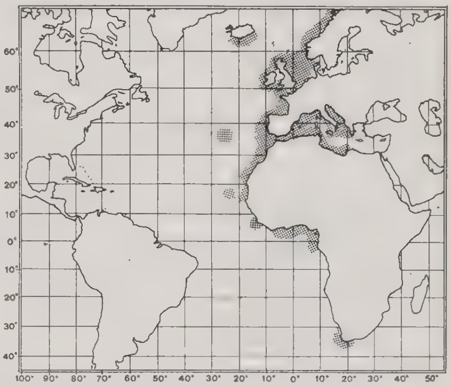


Geographical Distribution : Eastern Atlantic: Iceland and Norway to Morocco, Senegal, Sierra Leone, Ivory Coast to Nigeria, Cameroon to Gabon; Azores, Cape Verde Islands; western Mediterranean; Cape Province, South Africa.

Habitat and Biology : A common lanternshark found on, near or well above the bottom on the outer continental shelves and upper slopes at depths of 70 to 2000 m, mostly between 200 and 500 m. Ovoviviparous, litter size from 6 to 20. Feeds on small fishes, squids and crustaceans.

Size : Maximum total length about 60 cm, rare above 45 cm, maturing between 33 and 36 cm, and born at about 12 to 14 cm.

Interest to Fisheries : Caught offshore in the eastern Atlantic with bottom and pelagic trawls, and utilized for fishmeal and prepared dried salted for human consumption. Probably relatively unimportant, but statistics for catches of this species are lacking.

Literature : Bigelow & Schroeder (1957); Krefft (1968); Wheeler (1978); Cadenat & Blache (1981); Compagno (1981).

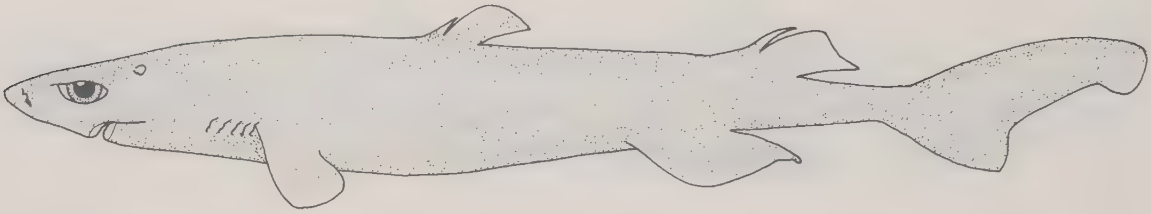
Etmopterus unicolor (Engelhardt, 1912)

SQUAL Etmo 15

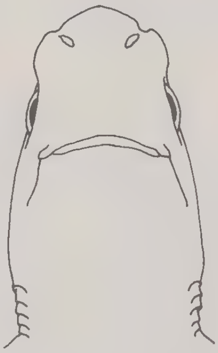
Spinax unicolor Engelhardt, 1912, *Zool.Anz.*, 39:645. Holotype : 550 mm female. Type Locality : Sagami Bay, Honshu, Japan.

Synonymy : None.

FAO Names : En - Brown lanternshark; Fr - Sagre brun; Sp - Tollo lucero marrón.



Diagnostic Features : A stout-bodied lanternshark with a moderately long tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to spiracles, about 2 times in distance between pectoral and pelvic bases, and about 1.5 times interdorsal space; distance between pectoral and pelvic bases moderately long in adults, about 1.2 times head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal rear tip. Head width about 1.5 times preoral snout; prespiracular length about equal to distance from spiracles to pectoral origins; gill openings fairly large, wider than spiracle, 1/2 eye length; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin behind free rear tips of pectoral fins, dorsal fin base somewhat closer to pectoral bases than pelvics; interdorsal space short, almost equal to head length, to pectoral midbases; second dorsal fin larger than first, its area about half again that of first; distance between second dorsal base and upper caudal origin about 2 in interdorsal space; caudal fin moderately long, length of dorsal caudal margin about equal to head length. Lateral trunk denticles with slender hooked conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour dark brown or grey-brown, with inconspicuous dark lower surface and a broad, elongated mark on tail above pelvic fins.



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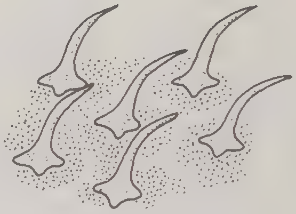
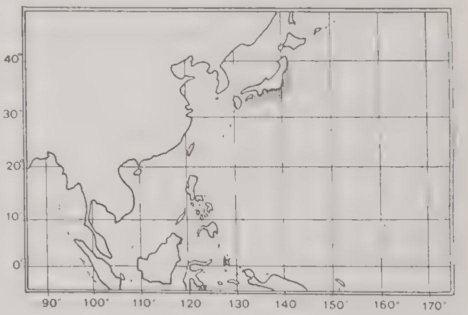


dermal denticles

Geographical Distribution : Western North Pacific: Japan (southeastern Honshu).



Habitat and Biology : A little-known lanternshark, biology almost unknown.

Size : Maximum total length at least 53 cm, adult males to 48 cm, adult females to 53 cm.

Interest to Fisheries : None at present.

Literature : Abe (1965).

Remarks : The account of this species is based on Abe's (1965) redescription.

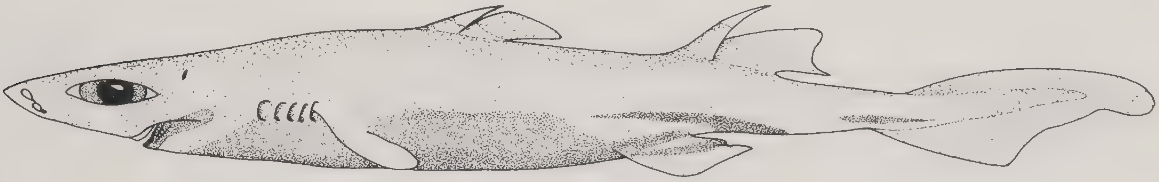
Etmopterus villosus Gilbert, 1905

SQUAL Etmo 16

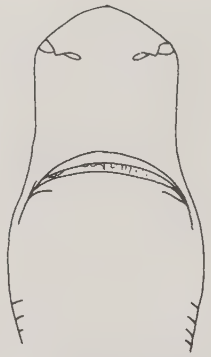
Etmopterus villosus Gilbert, 1905, Bull.U.S.Fish Comm., 23(2):580, pl. 56. Holotype : U.S. National Museum of Natural History, USNM 51583, 170 mm immature male. Type Locality : Hawaiian Islands, off south coast of Molokai, 406 to 911 m.

Synonymy : None.

FAO Names : En - Hawaiian lanternshark; Fr - Sagre diablotin; Sp - Tollo lucero de Hawaii.



Diagnostic Features : A stout-bodied lanternshark with a short tail, distance from pelvic insertions to ventral caudal origin about as long as from tip of snout to spiracles, slightly less than 1.5 times in distance between pectoral and pelvic bases, and about 0.8 of interdorsal space; distance between pectoral and pelvic bases short in holotype, about equal to prebranchial length; distance from snout tip to first dorsal spine almost equal to distance from first dorsal spine to upper caudal origin. Head width about 1.2 times preoral snout; prespiracular length 1.5 times distance from spiracles to pectoral origins; gill openings moderately long, wider than spiracle, but about 1/4 eye length; upper teeth with less than 3 pairs of cusplets. Origin of first dorsal fin over inner margins of pectoral fins, dorsal fin base much closer to pectoral bases than pelvics; interdorsal space short, slightly less than prespiracular length; second dorsal fin much larger than first, somewhat less than twice its area; distance between second dorsal base and upper caudal origin about 1.2 in interdorsal space; caudal fin fairly short and broad, length of dorsal caudal margin about equal to distance from snout tip to first gill slits. Lateral trunk denticles with slender, hooked conical crowns, wide-spaced and arranged in regular longitudinal rows on rear of trunk and tail; snout covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour dark brown or blackish above and below, with underside of snout, mouth and abdomen somewhat darker, with an indistinct black mark running above pelvic fins.



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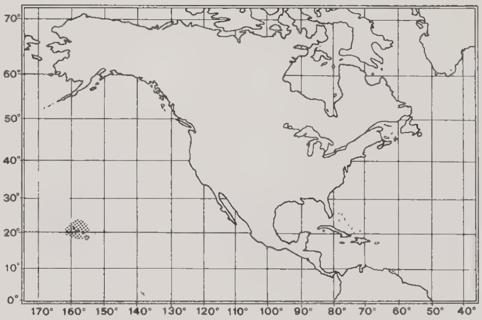
Geographical Distribution : Central Pacific: Hawaiian Islands (Molokai).



Habitat and Biology : A poorly-known lanternshark from the insular slopes of the Hawaiian Islands, on or near bottom at 406 to 911 m.

Size : The holotype is immature at 17 cm; other specimens have been collected, with a maximum total length of at least 46 cm for adults.

Interest to Fisheries : None at present.

Literature : Bigelow & Schroeder (1957); Clarke (1972).

Remarks : Illustration and account based on the holotype.

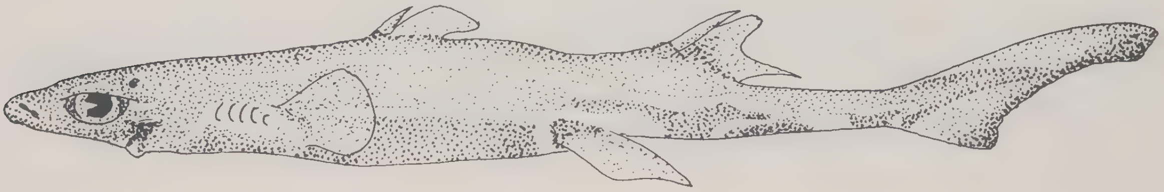
Etmopterus virens Bigelow, Schroeder & Springer, 1953

SQUAL Etmo 17

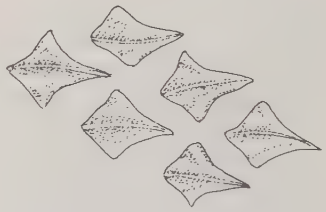
Etmopterus virens Bigelow, Schroeder & Springer, 1953, Bull.Mus.Comp.Zool.Harv.Univ., 109(3):257, figs 6D, 10. Holotype : U.S. National Museum of Natural History, USNM 160859, 203 mm adult male. Type Locality : Northern Gulf of Mexico, 29°52'N, 91°33'W, 403 m depth.

Synonymy : None.

FAO Names : En - Green lanternshark; Fr - Sagre vert; Sp - Tollo lucero verde.

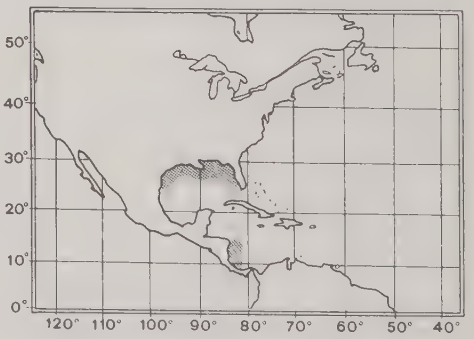


Diagnostic Features : A moderately slender-bodied lanternshark with a long tail, distance from pelvic insertions to ventral caudal origin about as long as head, about equal to distance between pectoral and pelvic bases, and about 1.4 times interdorsal space; distance between pectoral and pelvic bases moderately long in adults, slightly less than head length; distance from snout tip to first dorsal spine about equal to distance from first dorsal spine to second dorsal insertion. Head width about equal to preoral snout; prespiracular length about equal to distance from spiracles to pectoral origins; gill openings very short, about as wide as spiracle, 1/3 eye length or less; upper teeth generally with less than 3 pairs of cusplets. Origin of first dorsal fin opposite inner margins of pectoral fins, dorsal fin base much closer to pectoral bases than pelvics; interdorsal space short, about as long as distance from snout tip to first gill slits; second drosal fin much larger than first, over twice its area; distance between second dorsal base and upper caudal origin about 1.4 in interdorsal space; caudal fin long and narrow, length of dorsal caudal margin about equal to head length. Lateral trunk denticles with very short, stout, hooked, conical crowns, wide-spaced but not arranged in regular longitudinal rows; snout largely covered with denticles; no rows of greatly enlarged denticles on flanks above pectoral fins. Distal margins of fins largely covered with skin, not fringed with naked ceratotrichia. Colour dark brown or grey-black, with underside of snout and abdomen black, an elongated broad black mark running above and behind pelvic fins, and other elongated black marks at caudal fin base and along its axis.



dermal denticles

Geographical Distribution : Western North Atlantic: Northern Gulf of Mexico, Texas to Florida (USA), Nicaragua.



Habitat and Biology : A common lanternshark of the upper continental slopes at depths of 348 to 465 m. Caught in considerable numbers sporadically, suggesting that this shark occurs in schools. Pieces of rather large squid found in the stomachs of these sharks suggest that they may feed communally, with an entire school attacking and demolishing squid that would be normally too large for a single individual to overcome.

Size : Maximum total length about 23 cm; adult males 20 to 23 cm, adult females 23 cm.

Interest to Fisheries : None at present.

Literature : Bigelow, Schroeder & Springer (1953); Bigelow & Schroeder (1957); Springer (1967); Cadenat & Blache (1981).

Euprotomicroides Hulley & Penrith, 1966

SQUAL Eup

Genus : *Euprotomicroides* Hulley & Penrith, 1966, *Bull.Mar.Sci.*, 16(2):222.

Type Species : *Euprotomicroides zantedeschia* Hulley & Penrith, 1966, by monotypy.

Synonymy : None.

Diagnostic Features : Anterior nasal flaps very short, not expanded into barbels; snout moderately long, compressed and conical, length about 2/5 of head length and less than distance from mouth to pectoral origins; gill openings increasing in size from front to back, 5th over twice length of first; lips thick, fringed, but not suctorial; teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, broad, nearly erect cusp and distal blade, edges not serrated; tooth rows 29/34. Both dorsal fins spineless; first dorsal origin well behind free rear tips of pectoral fins, insertion about equidistant between pectoral and pelvic bases and well ahead of pelvic origins; second dorsal fin somewhat larger than first, base less than 1.5 times length of first dorsal base; origin of second dorsal well ahead of pelvic origins; pectoral fins with greatly expanded, broadly lobate free rear tips and inner margins, much as in chimaeras; caudal fin asymmetrical, not paddle-shaped, upper lobe long, lower lobe moderately long, subterminal notch well-developed. No precaudal pits or lateral keels on caudal peduncle, but with a midventral keel. Dermal denticles flat and blocklike, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca greatly expanded and modified as a luminous gland with secretory papillae. Colour blackish brown with conspicuous light fin margins.

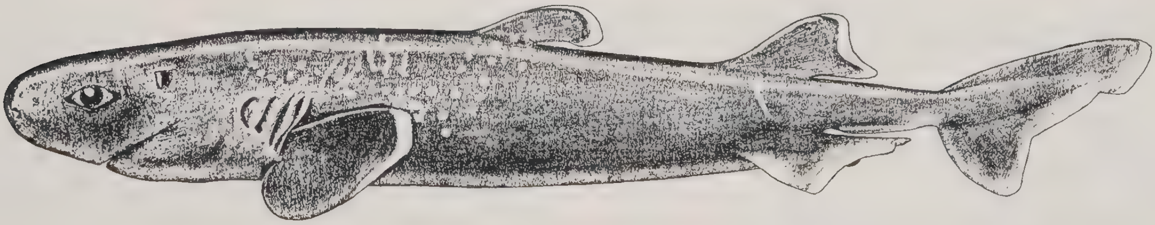
Euprotomicroides zantedeschia Hulley & Penrith, 1966

SQUAL Eup 1

Euprotomicroides zantedeschia Hulley & Penrith, 1966, *Bull.Mar.Sci.*, 16(2):222, fig. 1-4. Holotype : South African Museum, SAM 23577, 176 mm immature female. Type Locality : West of Cape Town, South Africa, 457 to 640 m depth.

Synonymy : None.

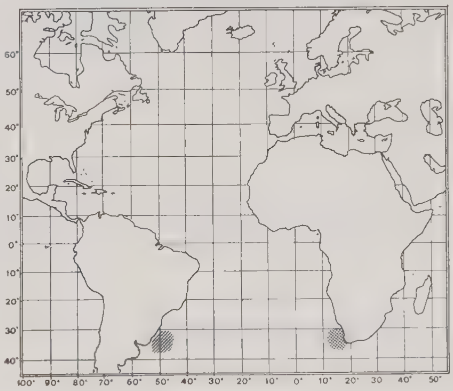
FAO Names : En - Taillight shark; Fr - Squale à queue claire; Sp - Tollo rabo claro.



Field Marks : Conical, moderately long, blunt, compressed snout, compressed body, no dorsal fin spines, cloacal gland, lobate, chimaera-like pectoral fins, no anal fin, gill slits increasing greatly in size from front to back, midventral keel on caudal peduncle, asymmetrical caudal fin, needle-like upper teeth and bladelike lowers, dark colour with conspicuous light fin margins.

Diagnostic Features : See genus.

Geographical Distribution : South Atlantic: West of Cape Town, South Africa and east of Uruguay.



Habitat and Biology : A little-known, extraordinarily specialized, oceanic dwarf shark, known only from two specimens. One was caught near short in a bottom trawl (holotype), but a second specimen was captured near the surface (0 to 25 m deep) far offshore (Krefft, 1980). Mode of reproduction unknown, probably ovoviviparous with few young. The cloaca of this shark is greatly expanded into a gland with internal villi that secret a blue luminous substance (M. Stehmann, pers.comm.); this will be reported in detail elsewhere. The broadly lobate, muscular-based pectoral fins, situated on the compressed body in a position similar to the pectoral fins of chimaeras, suggest that pectoral propulsion or at least pectoral hovering is important in this shark. Food unknown; the powerful jaws and sharp lower teeth suggest that this species can take relatively large prey.

Size : An adult male was 41.6 cm long; the 17.6 cm holotype was originally recorded as an adult male, but turned out to be an immature female.

Interest to Fisheries : None.

Literature : Hulley & Penrith (1966); Bass, d'Aubrey & Kistnasamy (1976); Krefft (1980); M. Stehmann (pers.comm.).

Euprotomicrus Gill, 1864

SQUAL Eupr

Genus : Euprotomicrus Gill, 1864, Proc.Acad.Nat.Sci.Philad., 1864:264, ftn. 4.

Type Species : Scymnus labordii Quoy & Gaimard, in Müller & Henle, 1839, by monotypy, equals Scymnus bispinatus Quoy & Gaimard, 1824.

Synonymy : Euprotomycrus Andriashev, 1965 (error).

Diagnostic Features : Anterior nasal flaps very short, not expanded into barbels; snout moderately long, bulbously conical, length about 2/5 of head length and less than distance from mouth to pectoral origins; gill openings very small, uniformly broad; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, broad, nearly erect cusp and distal blade, edges not serrated; tooth rows 21/19-23. Both dorsal fins spineless; first dorsal origin far behind free rear tips of pectoral fins, insertion well ahead of pelvic origins but much closer to pelvic bases than pectorals; second dorsal fin much larger than first, with its base about 4 times as long as base of tiny first dorsal; origin of second dorsal over rear end of pelvic bases; pectoral fins with short, broadly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin nearly symmetrical, paddle-shaped, with short, strong upper lobe and long lower lobe, subterminal notch well-developed. No precaudal pits but with low lateral keels on caudal peduncle, no midventral keel. Dermal denticles flat and blocklike, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca normal, not expanded as a luminous gland. Colour blackish with conspicuously light-edged fins.

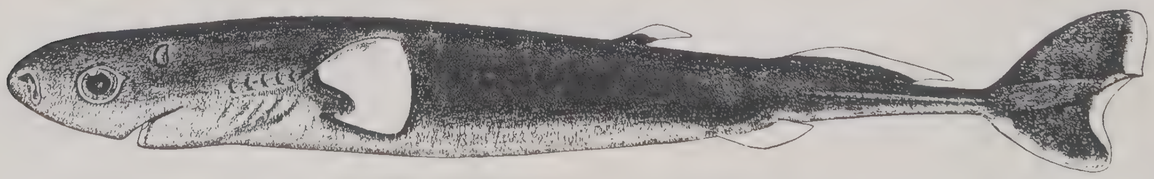
Euprotomicrus bispinatus (Quoy & Gaimard, 1824)

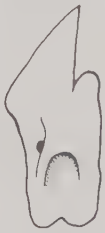
SQUAL Eupr 1

Scymnus bispinatus Quoy & Gaimard, 1824, Zoologie, Voy. Uranie et Physicienne, 1817-20:197, pl. 44, figs 1-2. Holotype : Muséum National d'Histoire Naturelle, Paris, MNHN 1216, 196 mm male. Type Locality : Mauritius, Indian Ocean.

Synonymy : Scymnus mauritanus Quoy & Gaimard, 1830; Scymnus (Laemargus) labordii Quoy & Gaimard, in Müller & Henle, 1839.

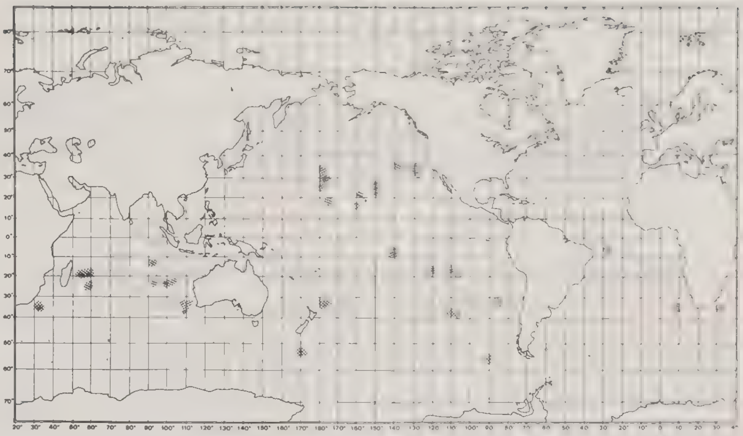
FAO Names : En - Pygmy shark; Fr - Squale pygmée; Sp - Tollo pigmeo.





tooth

Diagnostic Features : See genus.



Geographical Distribution : Oceanic and amphitemperate. South central Atlantic: Near Ascension Island, east of Fernando di Noronha Island, west of Cape of Good Hope, South Africa. Southern Indian Ocean: Madagascar to Western Australia. Southern central Pacific: Between New Zealand, Phoenix Island and southern Chile. Northern central and eastern Pacific: Midway and Hawaiian Islands to off California (USA).

Habitat and Biology : This pygmy shark is an epipelagic, mesopelagic, and perhaps bathypelagic inhabitant of the central water masses of the North and South Pacific, South Atlantic, and southern Indian Ocean, with water depths from 1829 to 9938 m. It occurs at or near the surface at night and apparently descends to at least midwater depths, to probably well below 300 m during the day; sand grains in the stomach of one specimen suggests that it may have been feeding on the bottom, presumably below 1800 m depth. All known specimens have been caught at the surface at night while none have been taken in midwater trawls at night or during the day. This also suggests that the diel vertical migrations of this little shark are enormous, at least 1500 or more metres each way to put it below the normal range of midwater trawl hauls in the day. In human terms this would be roughly equivalent to someone climbing at least 11 km up and down each day. Development ovoviviparous, with 8 young per litter. This shark eats deepwater squid and bony fishes with some crustaceans, but apparently does not take prey as relatively large as the squid taken by Isistius brasiliensis.

Size : Maximum total length 27 cm, males maturing between 17 to 19 cm and reaching 22 cm, females maturing between 22 and 23 cm and reaching 27 cm; size at birth greater than 6 cm and less than or about 10 cm.

Interest to Fisheries : None.

Literature : Bigelow & Schroeder (1957); Hubbs, Iwai & Matsubara (1967); Bass, d'Aubrey & Kistnasamy (1976); Seigel (1978); Cadenat & Blache (1981).

Heteroscymnoides Fowler, 1934

SQUAL Hetero

Genus : Heteroscymnoides Fowler, 1934, Proc.Acad.Nat.Sci.Philad., 85:239.

Type Species : Heteroscymnoides marleyi Fowler, 1934, by original designation.

Synonymy : Heteroscymnodes Fowler, 1969 (error).

Diagnostic Features : Anterior nasal flaps very short, not expanded into barbels; snout very long, bulbously conical, length almost half head length and about equal to distance from mouth to pectoral origins; gill openings very small, uniformly wide; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, moderately broad, semierect cusp and distal blade, edges no serrated; tooth rows 22/23. Both dorsal fins spineless; first dorsal well forward, origin over pectoral bases, insertion far ahead of pelvic origins and much closer to pectoral bases than pelvics; second dorsal fin slightly larger than first but with base about equal to first dorsal base; origin of second dorsal over midbase of pelvics; pectoral fins with short, narrowly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin semisymmetrical, almost paddle-shaped, with moderately long upper lobe and well-developed lower lobe, subterminal notch strong. No precaudal pits, lateral or midventral keels on caudal peduncle. Dermal denticles flap but with pedicels, with lanceolate, ridged, wedge-shaped, monocuspidate crowns. Cloaca normal, not expanded as a luminous gland. Colour brown with conspicuous light and dark banded fin margins.

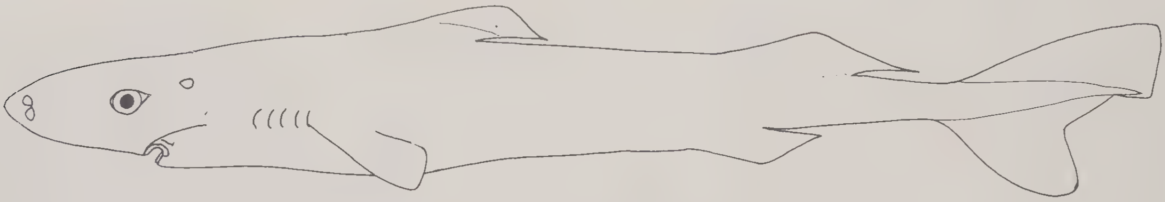
Heteroscymnoides marleyi Fowler, 1934

SQUAL Hetero 1

Heteroscymnoides marleyi Fowler, 1934, Proc.Acad.Nat.Sci.Philad., 85:240, fig. 4. Holotype : Academy of Natural Sciences, Philadelphia, ANSP 53046, 128 mm female. Type Locality : Western Indian Ocean, Durban coast at Point Ocean Beach, Natal, South Africa.

Synonymy : None.

FAO Names : En - Longnose pygmy shark; Fr - Squale mignon; Sp - Tollo pigmeo trompudo.

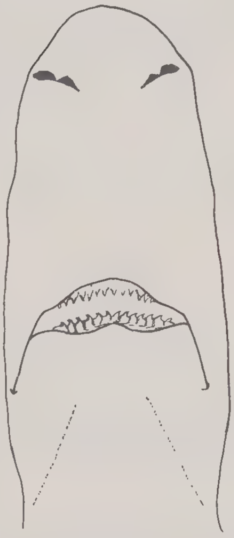


Field Marks : Small size, bulbous elongated snout, no dorsal fin spine; first dorsal fin far forward, with origin over pectoral bases, second dorsal only slightly larger than first, no anal fin, dark brown colour with light-edged fins.

Diagnostic Features : See genus.

Geographical Distribution : South central Atlantic: Near Ascension Island. Southwestern Indian Ocean: Durban, Natal, South Africa.

Habitat and Biology : A poorly known, apparently oceanic dwarf shark; the holotype was captured off a beach but a second specimen was recently taken in the Atlantic at night between the surface and 502 m (Krefft, 1980). Mode of reproduction unknown but probably ovoviviparous and with few young. Food unknown, presumably pelagic fish and invertebrates.



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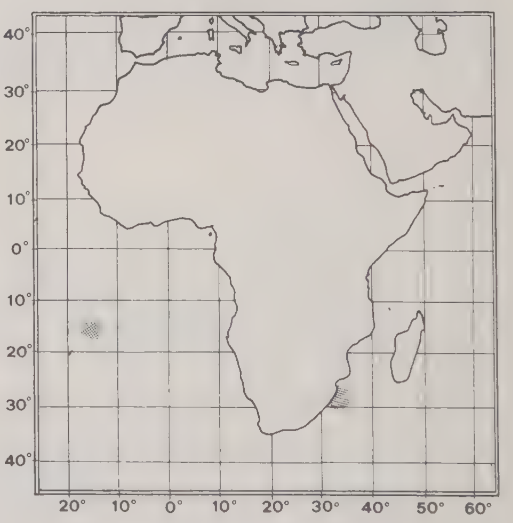


Size : Of two specimens, the 12.8 cm female holotype is immature and has an umbilical scar, indicating it is close to the size at birth; the 28.5 cm female reported by Krefft (1980) was not examined for maturity but judging from the size of the holotype and the relative size of full-term fetuses or newborn specimens and adult females in other small pelagic squaloids this specimen could very well be mature.

Interest to Fisheries : None.

Literature : Fowler (1941); Bigelow & Schroeder (1957); Bass, d'Aubrey & Kistnasamy (1976); Krefft (1980).

Isistius Gill, 1864

SQUAL Isist

Genus : Isistius Gill, 1864, Proc.Acad.Nat.Sci.Philad., 1864:264, ftn. 2.

Type Species : "Scymnus brasiliensis M(üller) & H(enle)", by monotypy, equals Scymnus brasiliensis Quoy & Gaimard, 1824.

Synonymy : Genus Leius Kner, 1865 (? 1864).

Field Marks : Small size, cigar-shaped body, small, spineless dorsal fins far posterior on back, no anal fin, huge, triangular-cusped lower teeth without blades, unique suctorial lips, short, bulbous snout.

Diagnostic Features : Anterior nasal flaps very short, not expanded into barbels; snout short, bulbously conical, length less than 2/5 of head length and much less than distance from mouth to pectoral origins; gill openings small, uniformly broad; lips expanded, fleshy, suctorial, allowing the shark to attach to its prey like a lamprey; teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers very large, bladelike, interlocked, with a high broad, erect cusp but no blade, edges not serrated; tooth rows 29-37/19-31. Both dorsal fins spineless; first dorsal fin far posterior, origin far behind pectoral fins and somewhat anterior to pelvic origins, insertion over pelvic bases; second dorsal fin slightly larger than first but with base about equal to first dorsal base; origin of second dorsal about over pelvic rear tips; pectoral fins with short, narrowly to broadly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin varying from asymmetrical to nearly symmetrical, paddle-shaped or not, with a short upper lobe, short to long lower lobe, and a strong subterminal notch. No precaudal pits but with low lateral keels on caudal peduncle, no midventral keel. Dermal denticles flat and blocklike, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca normal, not expanded as a luminous gland. Colour medium grey or grey-brown with light-edged fins.

Remarks : The arrangement of this genus follows Garrick & Springer (1964).

Key to Species :

1a. Lower teeth in 25 to 32 rows. Caudal large and with a long ventral lobe. A prominent dark collar marking around throat .... **I. brasiliensis**

1b. Lower teeth in 19 rows. Caudal small and with a short ventral lobe. No collar marking on throat .... **I. plutodus**

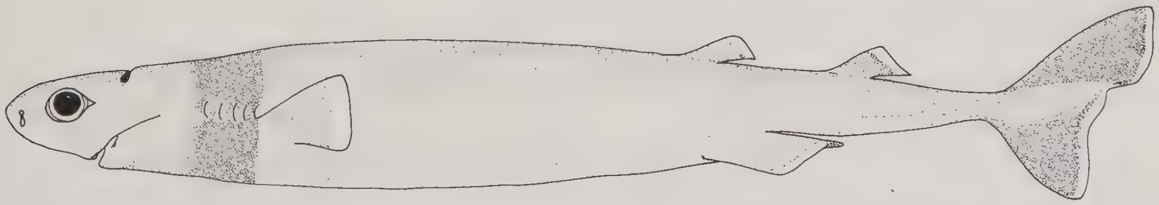
Isistius brasiliensis (Quoy & Gaimard, 1824)

SQUAL Isist 1

Scymnus brasiliensis Quoy & Gaimard, 1824, Zoologie, Voy. Uranie et Physicienne, 1817-20:198. Holotype : Muséum National d'Histoire Naturelle, Paris, MNHN A. 7787, 140 mm female. Type Locality : Brazil.

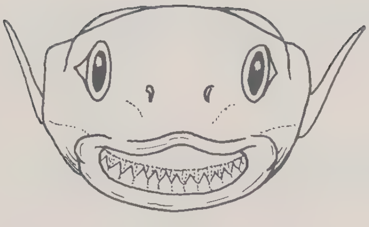
Synonymy : Squalus fulgens Bennett, 1840; Scymnus torquatus Valenciennes, in Müller & Henle, 1839; Scymnus unicolor Valenciennes, in Müller & Henle, 1839; Leius ferox Kner, 1865.

FAO Names : En - Cookiecutter shark; Fr - Squalelet féroce; Sp - Tollo cigarro.

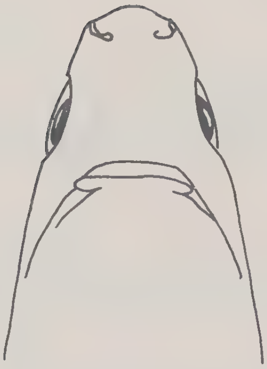


Field Marks : Small size, cigar-shaped body, small, spineless dorsal fins far posterior on back, no anal fin, triangular-cusped lower teeth without blades and in 25 to 31 rows, suctorial lips, short, bulbous snout, nearly symmetrical caudal fin with long ventral lobe.

Diagnostic Features : Snout moderately short, about length of eye; eyes anterior on head but sufficiently far back to lack an extensive anterior binocular field; teeth in 31 to 37/25 to 31 rows, lowers moderately large. Interdorsal space over twice first dorsal base, space between second dorsal insertion and upper caudal origin over twice second dorsal base; second dorsal height about equal to first; pectoral fins subquadrate, pelvic fins larger than dorsal fins; caudal fin large and nearly symmetrical, with a long ventral caudal lobe over 2/3 length of dorsal caudal margin. Colour: a prominent dark collar-marking over branchial region.



frontal view of head



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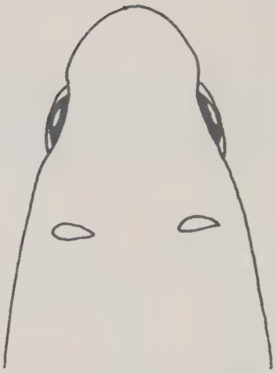
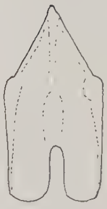
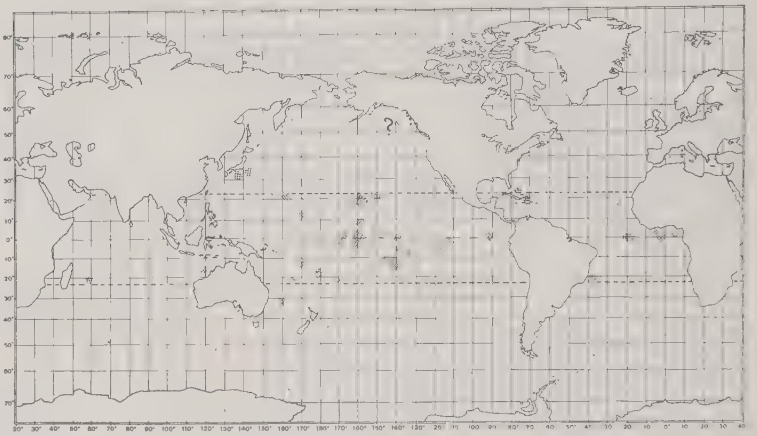


dorsal view of head



tooth



Geographical Distribution : Oceanic and circumtropical. Atlantic: Bahamas and southern Brazil to Cape Verde Island, Guinea to Sierra Leone, southern Angola and South Africa, including Ascension Island. Southern Indian Ocean: Mauritius to New Guinea and Western Australia. Pacific: Japan and Lord Howe Island to Hawaiian and Galapagos Islands.

Habitat and Biology : A wide-ranging tropical oceanic shark, epipelagic to bathypelagic in distribution. It is caught at night, sometimes at the surface but usually below it at depths between 85 and 3500 m, but its preferred depth range and maximum depth are uncertain. Apart from those captured at the surface specimens are generally taken in midwater nets fished over a wide depth range, and it is difficult to tell at what depth these sharks were captured. This shark is thought to be a vertical migrator on a diel cycle, coming to the surface and to the level of midwater trawl hauls at night and presumably dropping below this during the daytime. This implies a long vertical distance travelled, in excess of 2000 to 3000 m up and down in the ocean basins. These sharks are often caught near islands; this may imply an inshore pupping ground or merely the distribution of large potential victims. The cookiecutter shark may be capable of living in water of lower oxygen content than *Euprotomicrus bispinatus* or *Squaliolus laticaudus*, but this is hypothetical.

The small paired fins, long body cavity and enormous, oily liver of this shark point to its being neutrally buoyant and not dependent on forward motion and its fins for dynamic lift. The liver and body cavity is proportionately much larger than in *Euprotomicrus bispinatus* or *Squaliolus laticaudus*, and much more oil is present in its body cavity and gut. This may be an adaptation for greater depths than those attained by the other species, but may also compensate for its more highly calcified skeleton, which in turn may be necessary for supporting its activities in taking larger prey and gouging flesh from large animals. It can be quite quick and active when caught and can bite its captors if they are unwary.

This shark has luminous organs that cover the entire lower surface of its trunk with the exception of its fins and the dark collar marking. It is reported as glowing a bright, ghostly green.

Reproduction presumably ovoviviparous, but with embryos and litter size uncertain; 6 or 7 large eggs have been found in ovaries.

This shark has very powerful jaws and large teeth. It feeds on freeliving deepwater prey, including squid with bodies almost as large as itself, gonostomatids, and crustaceans, but is also a facultative ectoparasite on larger marine organisms. It has highly specialized suctorial lips and a strongly modified pharynx that allow it to attach to the sides of large bony fishes such as marlin, tuna, albacore, wahoo, and dolphinfishes, as well as dolphins and other cetaceans and even the megamouth shark (*Megachasma*). The shark then drives its razor-sharp sawlike lower dentition into the skin and flesh of its victim, twists about to cut out a conical plug of flesh, then pulls free with the plug cradled by its scooplike lower jaw and held by the hooklike upper teeth. This method of feeding leaves 'crater wounds' on victims which were long thought to be caused by bacteria or invertebrate parasites until Jones (1971) connected them to the cookiecutter shark. It has been hypothesized that the strong luminescense shown by this shark may serve to lure in other predators to attack it, with the result that the shark parasitizes them instead; incomplete crater wounds often show that the cookiecutter shark attacked its victims head on, perhaps after they attacked it. Unusual non-edible victims of this shark include nuclear submarines of the US Navy, which have had rubber sonardomes bitten by *I. brasiliensis*. Despite its rather vampire-like mode of feeding, it is not dangerous to people because of its small size and habitat preferences; the chances of it attacking a swimmer or diver are remote though possible.

An unusual habit of this shark, perhaps related to maintaining sufficient calcium levels in its body, is swallowing and possibly digesting its own lower teeth as they are replaced and become loose in entire series.

Size : Maximum total length about 50 cm; males maturing at about 31 to 37 cm and reaching at least 39 cm, females maturing between 38 and 44 cm and reaching at least 50 cm.

Interest to Fisheries : Of little interest to fisheries because of its small size and low abundance, but reportedly captured by bottom trawls and used for fishmeal in the eastern Atlantic. I. brasiliensis might be of slight negative interest to fisheries because the species gouges plugs of flesh from commercially important fishes, which may increase their mortality rate, but this is uncertain.

Local Names : USA: Cigar shark (American Fisheries Society).

Literature : Bigelow & Schroeder (1948, 1957); Strasburg (1963); Parin (1964); Garrick & Springer (1964); Hubbs, Iwai & Matsubara (1967); Jones (1971); Cadenat & Blache (1981).

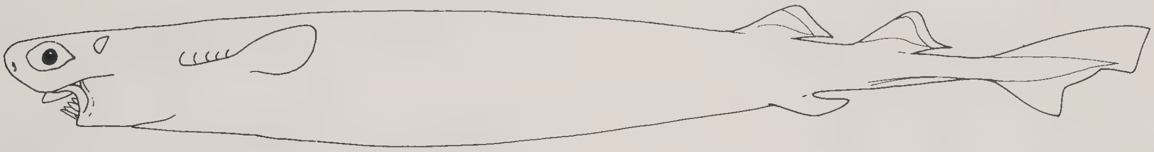
Isistius plutodus Garrick & Springer, 1964

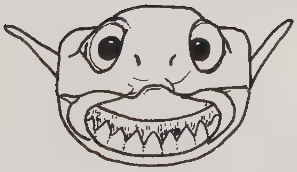
SQUAL Isist 2

Isistius plutodus Garrick & Springer, 1964, Copeia, 1964, no. 4:679, figs 1A, 2A, 2C, tab. 1. Holotype : US National Museum of Natural History, USNM 188386, 423 mm adult female. Type Locality : Gulf of Mexico off Alabama, $28^{0}58'$N, $88^{0}18'$W, over water from 814 to 997 m deep.

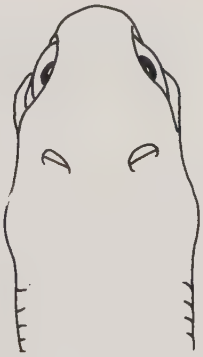
Synonymy : None.

FAO Names : En - Largetooth cookiecutter shark; Fr - Squalelet dentu; Sp - Tollo cigarro dentón.

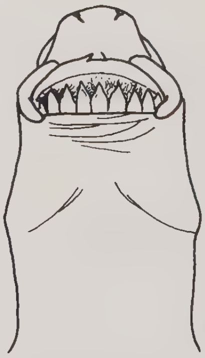




frontal view of head



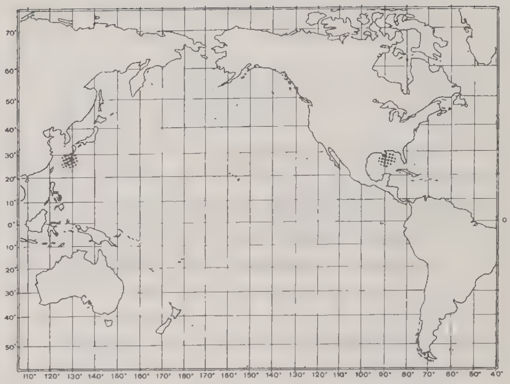
dorsal view of head



underside of head

Field Marks : Small size, cigar-shaped body, small, spineless, nearly equal-sized dorsal fins far posterior on back, no anal fin, huge, triangular-cusped lower teeth without blades and in 19 rows, suctorial lips, very short, bulbous snout, asymmetrical caudal fin with short ventral lobe.

Diagnostic Features : Snout very short, about length of eye; eyes set well forward on head, with extensive anterior binocular field; teeth in 29/19 rows, lower teeth enormous. Interdorsal space subequal to first dorsal base, space between second dorsal insertion and upper caudal origin about equal to second dorsal base; second dorsal height about 1.3 times first; pectoral fins rounded, pelvic fins smaller than dorsal fins; caudal fin small and noticeably asymmetrical, with a short ventral caudal lobe less than half length of dorsal caudal margin. Colour: no dark collar-marking over branchial region.



Geographical Distribution : Western North Atlantic: off Alabama (USA), Gulf of Mexico. Western North Pacific: off Okinawa (Japan).

Habitat and Biology : A little-known epipelagic and possibly bathypelagic shark, known from only two localities. Its infrequency of capture compared to I. brasiliensis suggests that it is either very localized in its distribution, or, perhaps more likely, is usually found in much deeper water than its congener. The small dorsal fins and caudal of this shark suggests that it is a weaker, less active swimmer than I. brasiliensis, that also takes advantage of a 'hepatic float'. However, its larger, more powerful jaws, bigger mouth and gigantic lower teeth (proportionately the largest in any living shark) equip it for taking larger bites out of its prey, something shown by a huge plug of bony fish flesh taken from the stomach of the holotype. This was as high and wide as the diameter of its mouth but over twice as long, and indicates with its suctorial lips and feeding apparatus that this shark is probably at least a facultative ectoparasite like its congener. Although this shark is probably capable of cutting circular plugs like I. brasiliensis, it apparently can readily gouge elongate plugs out of its victims, perhaps with a different action that the twisting motion required to cut out cones.

A curious feature of this shark is its extremely short snout and anteriorly positioned eyes. When viewed frontally the largetooth cookiecutter apparently has a broad anterior field of vision, unlike I. brasiliensis with its longer snout and more posterolaterally positioned eyes; this apparently allows for binocular vision, and may be helpful in precisely locating its victims prior to attacking them.

Size : Maximum total length at least 42 cm.

Interest to Fisheries : None, except as a possible causative agent of "crater wounds" on fishes such as scombrids, billfishes, etc., and hence of negative interest to fisheries.

Literature : Garrick & Springer (1964); Parin (1972); Bass, d'Aubrey & Kstnasamay (1976); Cadenat & Blache (1981).

Scymnodalatias Garrick, 1956

SQUAL Scym

Genus : Scymnodalatias Garrick, 1956, Trans.R.Soc.N.Z., 83(3):564.

Type Species : Scymnodon sherwoodi Archey, 1921, by original designation.

Synonymy : None.

Diagnostic Features : Anterior nasal flaps short, not expanded into barbels; snout moderately long, pointed and flattened, length about 2/5 head length and about 2/3 of distance from mouth to pectoral origins; gill openings moderately wide, last one slightly broader than first 4; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, uppers small, with very narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high broad, erect or semierect cusp and distal blade, edges not serrated; tooth rows 57/34. Both dorsal fins spineless; first dorsal somewhat posterior on back, origin well behind pectoral fins, insertion well anterior to pelvic origins but slightly closer to pelvic bases than to pectorals; second dorsal slightly larger than first but with base less than 1.5 times as long as first; origin of second dorsal fin over rear half of pelvic bases; pectoral fins with short, broadly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin asymmetrical, not paddle-shaped, with a long upper lobe, short lower lobe, and strong subterminal notch. No precaudal pits, lateral or midventral keels on caudal peduncle. Dermal denticles with moderately high, narrow pedicels and broad, flat, leaf-shaped, tricusped and triridged crowns. Cloaca normal, not expanded as a luminous gland. Colour uniform dark brown, apparently without conspicuous fin markings.

Remarks : This genus is very close to the genus Scymnodon, as suggested by the original placement of its single species. See Garrick (1956) for a detailed discussion of the characters and rationale for separating Scymnodalatias from other squaloid genera. In addition to lacking fin spines, this genus differs from Scymnodon in having the first dorsal fin slightly more posterior on the back. Prof J.A.F. Garrick (pers. comm.) has what apparently is a new species of Scymnodalatias, also from New Zealand waters.

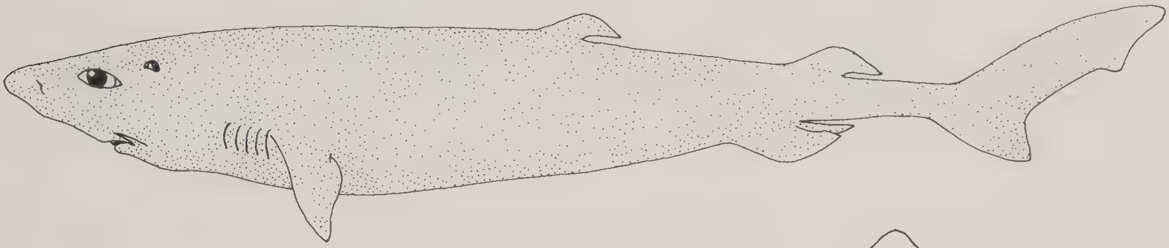
Scymnodalatias sherwoodi (Archey, 1921)

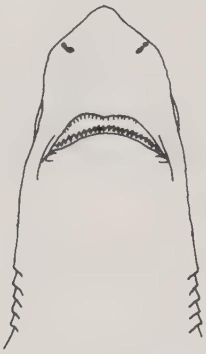
SQUAL Scym 1

Scymnodon sherwoodi Archey, 1921, Trans.New Zealand Inst., 53:195, fig. 1-2, pl. 39. Holotype : Canterbury Museum, 803 mm adult male. Type Locality : New Brighton Beach, Canterbury, New Zealand.

Synonymy : None.

FAO Names : En - Sherwood dogfish; Fr - Squale-grogneur chien; Sp - Bruja de Canterbury.





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Field Marks : Scymnodon-like, but with no dorsal spines and with the first dorsal slightly more posterior than in Scymnodon species; snout somewhat flattened, not bulbous, lower teeth with very high, erect or semi-erect cusps, distal blades and no serrations, first dorsal on middle of back behind pectoral fins, caudal fin asymmetrical, with a short lower lobe, fins without prominent light edges.

Diagnostic Features : See genus.

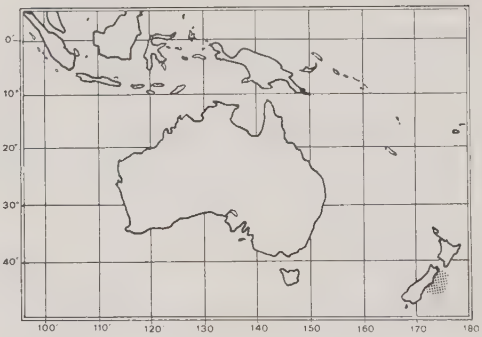
Geographical Distribution : Known only from the type locality.

Habitat and Biology : The only known specimen of this poorly known shark was found washed up on a beach; presumably the species inhabits the insular slope of New Zealand near the bottom or is oceanic or semi-oceanic. Virtually nothing is known of the biology of S. sherwoodi.

Size : Maximum total length of adult males at least 80.3 cm.

Interest to Fisheries : None.

Literature : Garrick (1956).



Scymnodon Bocage & Capello, 1864

SQUAL Scymn

Genus : Scymnodon Bocage & Capello, 1864, Proc.Zool.Soc.Lond., 24:263.

Type Species : Scymnodon ringens Bocage & Capello, 1864, by monotypy.

Synonymy : Genus Zameus Jordan & Fowler, 1903.

Field Marks : Dark colour, without conspicuous fin markings, no anal fin, small fin spines on both dorsals, moderately long snout, slender-cusped teeth without cusplets in upper jaw, bladelike, erect or semi-erect, large-cusped interlocked cutting teeth in lower jaw, pectoral fins with broadly rounded free rear tips, no keels on caudal peduncle.

Diagnostic Features : Anterior nasal flaps short, not expanded into barbels; snout moderately long, pointed and flattened, length about 2/5 of head length and 2/5 to 2/3 of distance from mouth to pectoral origins; gill openings moderately wide, last one slightly wider or narrower than first four; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, uppers small, with very narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, broad, erect or semierect cusp and distal blade, edges not serrated; tooth rows 57 to 59/31 to 33. Dorsal fins with small, somewhat inconspicuous, grooved spines, the second dorsal spine not markedly larger than the first; first dorsal somewhat posterior on back, origin over or well posterior to pectoral inner margins, insertion well anterior to pelvic origins but varying from slightly closer to the pelvic bases than the pectorals to vice versa; second dorsal slightly larger than first but with base less than 1.5 times as long as first; origin of second dorsal fin over about middle third of pelvic bases; pectoral fins with short, broadly rounded free rear tips and inner margins not expanded and acute or lobate; caudal fin asymmetrical, not paddle-shaped, with a long upper lobe, short to poorly differentiated lower lobe, and with subterminal notch varying from virtually absent to well-differentiated. No precaudal pits, lateral or midventral keels on caudal peduncle. Dermal denticles with moderately high, narrow pedicels and broad, flat leaf-shaped, tricusped and triridged crowns. Colour blackish brown or dark brown, without conspicuous fin markings.

Remarks : See Remarks above for the genus Centroscymnus for a discussion of the separation of that genus from Scymnodon. Zameus was proposed by Jordan & Fowler (1903) for S. squamulosus, a species very closely allied to the Atlantic S. obscurus but morphologically divergent from the type of Scymnodon, S. ringens. Zameus could be used to separate S. obscurus and S. squamulosus at the subgeneric or generic level if necessary. Garman (1913); Fowler (1941) and Garrick (1959b) all included Centrophorus plunketi Waite, 1909 in Scymnodon on denticle characters, but I follow Bigelow & Schroeder (1957) in placing it in Centroscymnus inasmuch as its teeth are closer to the Centroscymnus end of the Centroscymnus-Scymnodon continuum.

Key to Species :

1a. Snout very short. Mouth very large and broadly arched. Caudal fin with a weak subterminal notch .... **S. ringens**

1b. Snout moderately long. Mouth rather small and nearly transverse. Caudal fin with a strong subterminal notch .... **S. obscurus**
S. squamulosus

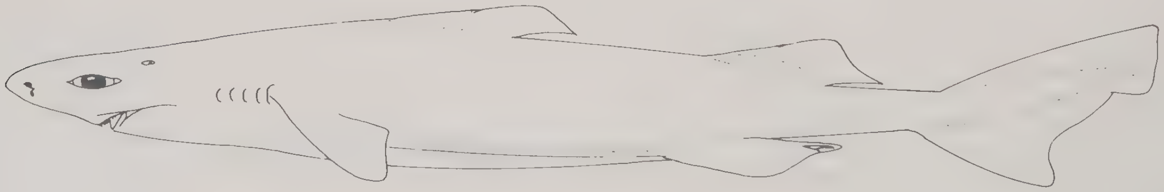
Scymnodon obscurus (Vaillant, 1888)

SQUAL Scymn 2

Centroscymnus obscurus Vaillant, 1888, Exped.Sci."Travailleur" et "Talisman", 1880-1883, Paris, Poissons:67, pl. 2, fig. 2. Holotype : Muséum National d'Histoire Naturelle, Paris, MNHN-84-388, 590 mm female. Type Locality : "Cotes du Soudan", 1400 to 1435 m depth.

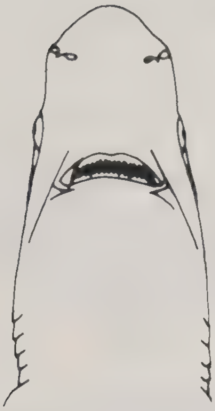
Synonymy : None.

FAO Names : En - Smallmouth velvet dogfish; Fr - Squale-grogneur à queue échancrée; Sp - Bruja bocachica.



Field Marks : Black coloration, small dorsal fin spines, no anal fin, moderately long snout, small lanceolate teeth without cusplets in upper jaw and large high, knife-cusped cutting teeth in lower jaw, mouth moderately wide and nearly transverse, caudal fin with strong subterminal notch and short lower lobe.

Diagnostic Features : Head rather low and flat; snout rather narrow and long, preoral length greater than mouth width and almost equal to distance from lower symphysis to first gill slits; mouth fairly narrow, short and transverse; postoral grooves very long, much longer than upper labial furrows; gill slits rather short, longest less



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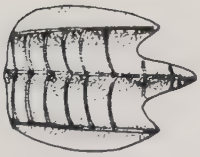
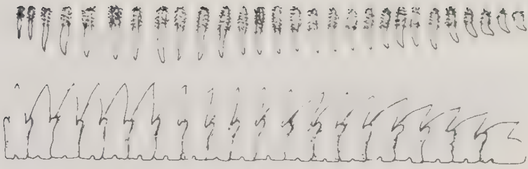
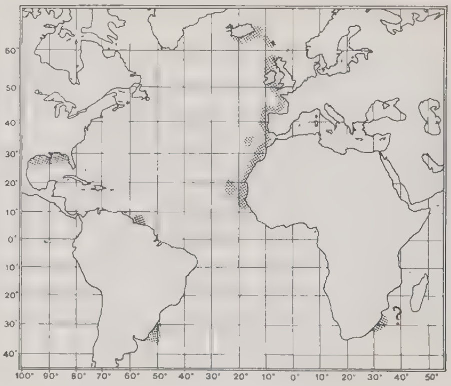


dermal denticle



upper and lower teeth of left side

than half eye length. Pectoral fins narrow and leaf-shaped; apices of pectoral fins falling well in front of first dorsal spine; pelvic fins small, about equal to second dorsal fin; caudal fin with a strong subterminal notch and a short lower lobe. Lateral trunk denticles with cross-ridges on crowns. Caudal peduncle long, distance from second dorsal base to upper caudal origin about equal to second dorsal base.



Geographical Distribution : Western Atlantic: Northern Gulf of Mexico; Surinam; southern Brazil. Eastern North Atlantic: Iceland and Faeroe Ridge to Madeira, Morocco, Cape Verde Islands, and Senegal. Western Indian Ocean: South Africa.

Habitat and Biology : A little-known deepwater shark of the Atlantic and possibly Indian Ocean continental slopes, usually found on or near the bottom at depths of 550 to 1450 m; also epipelagic and oceanic off Brazil at depths between 0 and 580 m in water 2000 m deep. Probably ovoviviparous and a predator on bottom fishes and invertebrates, but its smaller teeth and mouth, and weaker jaws suggest that it is a predator less capable of killing large prey than its congener S. ringens.

Size : Maximum total length about 59 cm; an adult male 51 cm, and an adult female 59 cm long.

Interest to Fisheries : Reported as being caught in bottom trawls, with line gear, and with fixed bottom nets in the eastern Atlantic, and utilized dried salted for human consumption and for fishmeal.

Literature : Bigelow & Schroeder (1957); Krefft & Stehmann (1973); Bass, d'Aubrey & Kistnasamy (1976); Krefft (1980); S. Springer (pers. comm.).

Remarks : As described by Krefft (1980) this species is very close to S. squamulosus and may be a junior synonym of that species.

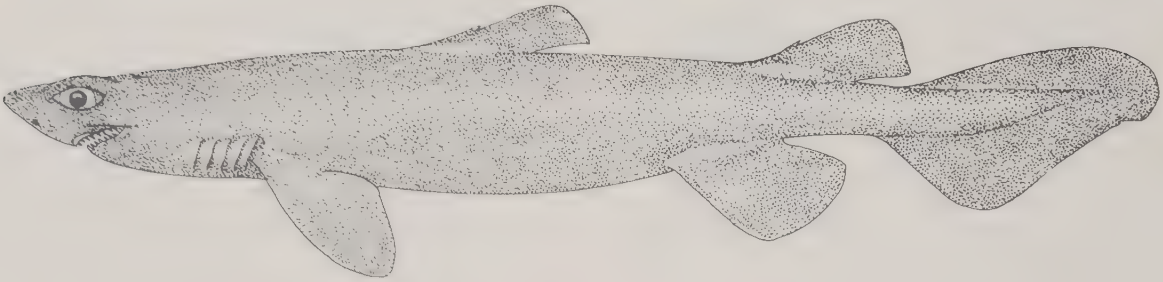
Scymnodon ringens Bocage & Capello, 1864

SQUAL Scymn 1

Scymnodon ringens Bocage & Capello, 1864, Proc.Zool.Soc.Lond., 24:263, fig. 5. Holotype : Possible syntype in British Museum (Natural History), BMNH 1867.7.23.3. Type Locality : Off Portugal.

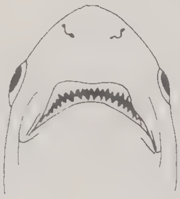
Synonymy : None.

FAO Names : En - Knifetooth dogfish; Fr - Squale-grogneur commun; Sp - Bruja.



Field Marks : Black coloration, small dorsal fin spines, no anal fin, short snout, small lanceolate teeth without cusplets in upper jaw and huge high, knife-cusped cutting teeth in lower jaw, mouth very wide and broadly arched, caudal fin with weak subterminal notch and no lower lobe.

Diagnostic Features : Head rather thick and high; snout broad and short, preoral length less than mouth width and less than distance from lower symphysis to first gill slits; mouth very wide, rather long and broadly arched; postoral grooves very short, much shorter than upper labial furrows; gill slits rather long, longest over half eye length. Pectoral fins narrow and leaf-shaped; apices of pectoral fins nearly reaching base of first dorsal spine; caudal fin with a weak subterminal notch and no lower lobe. Lateral trunk denticles without cross-ridges on crowns. Caudal peduncle short, distance from second dorsal base to upper caudal origin about half second dorsal base.



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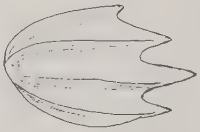
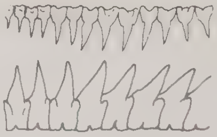


dermal denticle



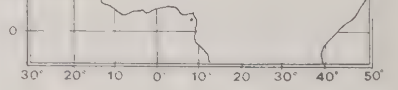
upper and lower teeth at centre of jaws

Geographical Distribution : Eastern Atlantic: Atlantic slope from Scotland to Spain, Portugal, Senegal.

Habitat and Biology : A little-known but not uncommon deepwater, temperate to subtropical shark that is essentially confined to the eastern Atlantic continental slope, on or near the bottom at depths of 200 to 1600 m. Probably ovoviviparous. The immense, triangular, razor-edged lower teeth of this shark suggests that it is a formidable predator, that is capable of attacking and dismembering large prey.

Size : Maximum total length about 110 cm.

Interest to Fisheries : Reported as being caught in bottom trawls, with line gear, and with fixed bottom nets in the eastern Atlantic, and utilized dried salted for human consumption and for fishmeal.



Literature : Bigelow & Schroeder (1957); Maurin & Bonnet (1970); Krefft & Stehmann (1973).

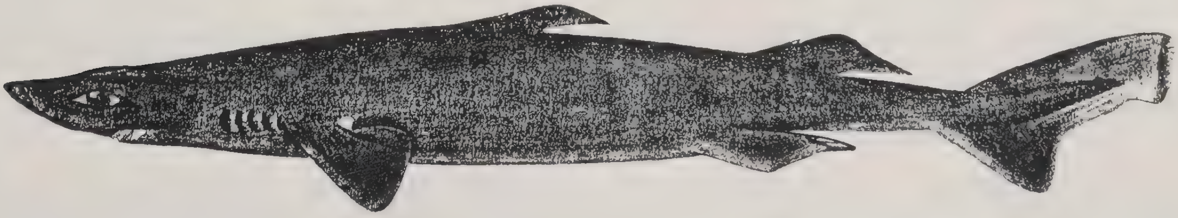
Scymnodon squamulosus (Günther, 1877)

SQUAL Scymn 3

Centrophorus squamulosus Günther, 1877, *Ann.Mag.Nat.Hist.*, ser.4, 20(119):433. Holotype : British Museum (Natural History), adult female about 690 mm long. Type Locality : Off "Inosima", Japan, 631 m depth.

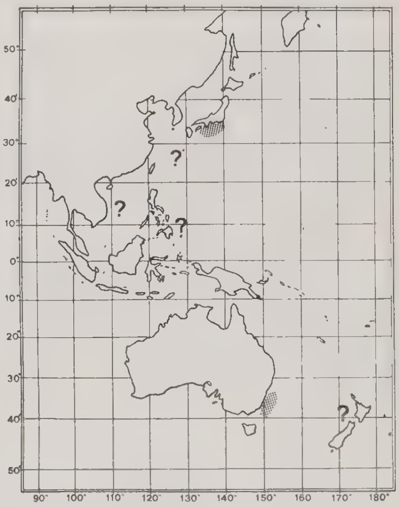
Synonymy : ? *Scymnodon niger* Chu *et al.*, 1982.

FAO Names : En - Velvet dogfish; Fr - Squale-grogneur velouté; Sp - Bruja terciopelo.



Field Marks : Black coloration, small dorsal fin spines, no anal fin, moderately long snout, small lanceolate teeth without cusplets in upper jaw and large high, knife-cusped cutting teeth in lower jaw, mouth moderately wide and nearly transverse, caudal fin with strong subterminal notch and short lower lobe.

Diagnostic Features : Head rather low and flat; snout rather narrow and long, preoral length greater than mouth width and almost equal to distance from lower symphysis to first gill slits; mouth fairly narrow, short and transverse; postoral grooves very long, much longer than upper labial furrows; gill slits rather short, longest less than half eye length. Pectoral fins fairly broad and leaf-shaped; apices of pectoral fins falling well in front of first dorsal spine; pelvic fins small, about equal to second dorsal fin; caudal fin with a strong subterminal notch and a short lower lobe. Lateral trunk denticles with cross-ridges on crowns. Caudal peduncle long, distance from second dorsal base to upper caudal origin about equal to second dorsal base.



Geographical Distribution : Western Pacific: Japan (southeastern Honshu), probably also Kyushu-Palau Ridge; very similar and probably identical dogfish occur in the South China Sea, off southeastern Australia (New South Wales) and New Zealand.

Habitat and Biology : A little-known deepwater shark of the western Pacific continental slope, down to at least 631 m.

Size : Maximum total length reported the adult female holotype of about 69 cm; male adult at 49 cm.

Interest to Fisheries : None.

Literature : Bigelow & Schroeder (1957); Nakaya (1982); Chu *et al.* (1982); J.A.F. Garrick & L. Paul (pers. comm.).

Remarks : Nakaya (1982) reported a *Scymnodon* from the Kyushu-Palau Ridge as *S. obscurus*, because of the presence of transverse ridges on its denticles, said by Bigelow & Schroeder (1957) to differentiate it from *S. squamulosus*. Although the writer was unable to examine the holotype of *S. squamulosus* in the British Museum (Natural History), he examined a very similar adult male *Scymnodon*, 49 cm long from Japan in the Stanford University collection; this proved to have denticles with transverse ridges like specimens of *S. obscurus*, and leads the writer to suspect that the holotype of *squamulosus* has these ridges also. Meanwhile, Chu *et al.* (1982) reported on *Scymnodon* material from the South China Sea similar to Nakaya's, but unfortunately named a new species for it, *S. niger*. The writer has examined similar *Scymnodon* specimens from New Zealand and Australia that are again similar to the Japanese, Kyushu-Palau Ridge, and South China Sea material, and suspects that all of these specimens may represent a single species, *S. squamulosus*. If *S. squamulosus* also has transverse ridges on its denticles, there are apparently no characters to differentiate this species from *S. obscurus* and hence the two species may be synonyms, as suspected by Krefft (1980).

Somniosus LeSueur, 1818

SQUAL Somn

Genus : Subgenus Somniosus LeSueur, 1818 (Genus Squalus Linnaeus, 1758), J.Acad.Sci.Philad., 1(pt. 2):222 (proposed as a subgenus but used in generic form).

Type Species : Somniosus/Squalus brevipinna LeSueur, 1818, by monotypy; a junior synonym of Squalus microcephalus Bloch & Schneider, 1801.

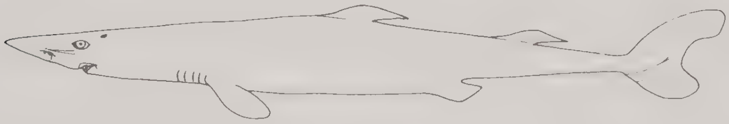
Synonymy : Genus Somnolentus Swainson, 1838; Subgenus Laemargus Müller & Henle, 1839 (Genus Scymnus Cuvier, 1817); Genus Leiodon Wood, 1846; Genus Rhinoscymnus Gill, 1864; Genus Heteroscymnus Tanaka, 1912; Subgenus Brevisomniosus Quéro, 1976 (Genus Somniosus LeSueur, 1818).

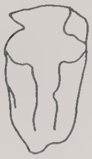
Field Marks : Short to moderately long snout, no fin spines on dorsals, no anal fin, slender-cusped teeth without cusplets in upper jaw, bladelike, oblique and relatively short-cusped teeth in lower jaw, denticles with narrow, hooked, cuspidate crowns, lips not fringed and pleated, first dorsal fin on middle of back and usually behind pectoral fins, but well ahead of pelvic fins, second dorsal fin slightly smaller than first, caudal fin somewhat paddle-shaped, with a long lower lobe, size moderate large to very large.

Diagnostic Features : Anterior nasal flaps short, not expanded into barbels; snout short to moderately long, broadly rounded to pointed and somewhat flattened, length 2/5 to less than 1/3 of head length and 2/3 to less than 2/5 of distance from mouth to pectoral origins; gill openings moderately wide, last one about as long as first four; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, upper small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a low to moderately high, oblique or semierect cusps and distal blade, edges serrated or not; tooth rows 35 to 63/34 to 68. Both dorsal fins spineless; first dorsal fin on middle of back, with origin sometimes extended forward as a low ridge over pectoral bases but usually well behind pectorals, insertion far in front of pelvic origins but slightly closer to pelvic bases than pectorals; second dorsal slightly smaller than first and with base 3/4 length of first dorsal base or less; origin of second dorsal varying from over anterior half of pelvic bases to somewhat posterior to pelvic free rear tips; pectoral fins with short, narrowly to broadly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin semisymmetrical and paddle-shaped, with a relatively short upper lobe and long lower lobe, and a strong subterminal notch. No precaudal pits, or lateral keels, or midventral keels on caudal peduncle. Dermal denticles with oblique to erect, ridged hooked, cuspidate narrow crowns, not flat, depressed and blocklike. Cloaca normal, not expanded as a luminous gland. Colour medium grey to blackish, without conspicuous light fin edges.

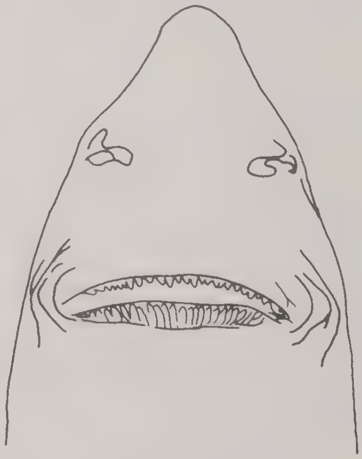
Remarks : There have been reviews of this genus in Bigelow & Schroeder (1957), Bass, d'Aubrey & Kistnasamy (1976), and Quéro (1976). As noted by Quéro (1976), the species of Somniosus fall in two very well-defined groups, which can be ranked as subgenera: Somniosus, for the two large species S. microcephalus and S. pacificus; and a group for the small species S. rostratus (and its synonyms) which Quéro named as a new subgenus, Brevisomniosus. However, Brevisomniosus is long antedated by Rhinoscymnus Gill, 1864 (and also Heteroscymnus Tanaka, 1912), which has as its type species Scymnus rostratus Risso, 1826. Heteroscymnus was often recognized as a distinct genus before Bigelow & Schroeder (1957) synonymized it with the genus Somniosus, and it is herein ranked as a junior synonym of the subgenus Rhinoscymnus Gill, 1864.

Another species of Somniosus may be present in the eastern Atlantic but has yet to be named. Bigelow & Schroeder (1957) and Quéro (1976) noted that a Somniosus specimen in the Bocage Museum in Lisbon, Portugal, captured off Portugal, differed from all other species in having an extremely long head, long, pointed snout, and a long, slender caudal peduncle. Unfortunately this specimen was lost in the fire that recently destroyed the Bocage Museum, and no other specimens like it are in existence in other museum collections. A figure of this specimen is given here.





tooth



underside of head

The treatment of species used here differs from Bigelow & Schroeder (1957), Quéro (1976) and Cadenat & Blache (1981) in recognizing only Somniosus microcephalus, S. pacificus, and S. rostratus; Fulgosi & Gandolfi (1983) independently came to similar conclusions on the number of valid species in this genus.

Key to Species :

1a. Lower teeth with low roots and high, slender, semierect cusps. Number of tooth rows 57 to 63/33 to 36. A short lateral keel present on caudal fin base. Small sharks, with adults less than 1.5 m .... S. rostratus

1b. Lower teeth with high roots and low, broad, oblique cusps. Number of tooth rows 35 to 52/48 to 58. No lateral keel on caudal fin base. Gigantic sharks, with adults to 4 or more metres.

- 2a. Interdorsal space at least as long as prebranchial length .... S. microcephalus
- 2b. Interdorsal space about 2/3 of prebranchial length .... S. pacificus

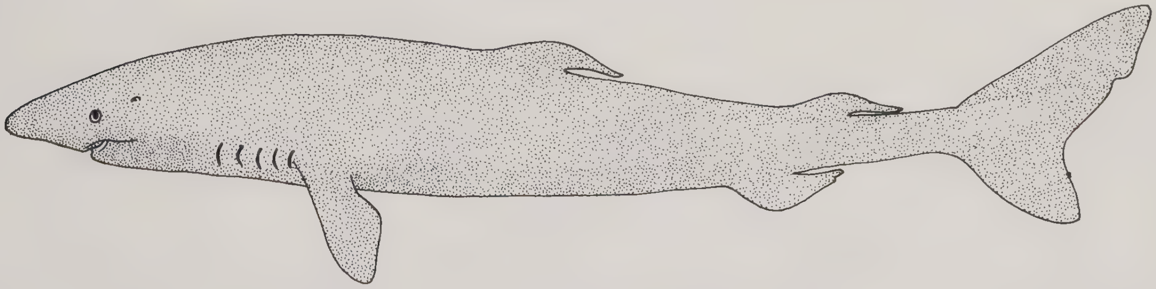
Somniosus microcephalus (Bloch & Schneider, 1801)

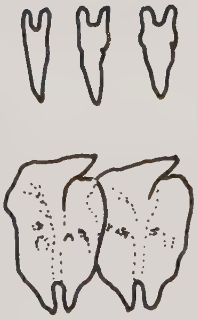
SQUAL Somn 2

Squalus microcephalus Bloch & Schneider, 1801, Syst.Ichthyol., Berlin :135. Holotype : Unknown. Type Locality : "Habitat in mari glaciali".

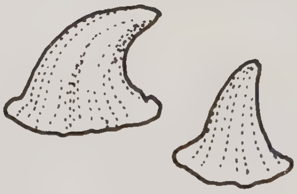
Synonymy : Squalus carcharis Gunnerus, 1766 (not Linnaeus, 1758 = Carcharodon carcharis); Squalus squatina Pallas, 1814 (not Linnaeus, 1758 = Squatina squatina); Squalus (Acanthorhinus) norwegianus Blainville, 1816 (nomen nudum), also Blainville, 1825, as S. norvegianus; Squalus or Somniosus brevipinna LeSueur, 1818; Squalus borealis Scoresby, 1820; Scymnus gunneri Thienemann, 1828; Scymnus glacialis Faber, 1829; Scymnus micropterus Valenciennes, 1832; Leiodon echinatum Wood, 1846; Somniosus antarcticus Whitley, 1939? (see discussion below).

FAO Names : En - Greenland shark; Fr - Laimargue du Groenland; Sp - Tollo de Groenlandia.





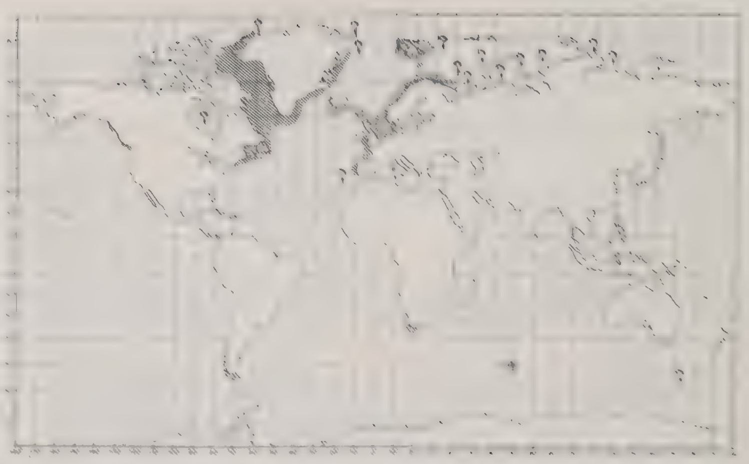
upper and lower teeth



dermal denticles

Field Marks : Short, rounded snout, heavy cylindrical body and small precaudal fins, two spineless, equal-sized dorsal fins, no anal fin, long ventral caudal lobe, first dorsal fin on back slightly closer to pelvics than pectoral fins, interdorsal space greater than distance from snout to second gill slits, no keels on base of caudal fin, upper teeth lanceolate, lower teeth with short, low, strongly oblique cusps and high, narrow roots.

Diagnostic Features : Head moderately long, length from snout to pectoral fins 23% total length in specimen 299 cm total length; snout short and broadly rounded. Cusps of lower teeth short and low, strongly oblique, roots very high; total tooth rows 45 to 52/48 to 53. Insertion of first dorsal fin slightly closer to pelvic bases than pectoral bases; interdorsal space greater than distance from snout tip to second gill slits. No lateral keels present on base of caudal fin. Caudal peduncle short, distance from second dorsal insertion to upper caudal origin less than twice second dorsal base, distance from pelvic insertions to lower caudal origin less than dorsal caudal margin. Vertebral column without well-defined calcified centra, notochord secondarily expanded. Size large, exceeding 4 m.



Geographical Distribution : North Atlantic and Arctic: From Cape Cod and the Gulf of Maine and Gulf of St. Lawrence to Ellesmere Island, Greenland, Iceland, Spitzbergen, the Arctic USSR (White Sea), and Norway to the North Sea and occasionally south to the Seine River mouth, France and possibly Portugal. South Atlantic and Antarctic: South Africa (Cape Columbine), Kerguelen Island, and possibly Macquarie Island.

Habitat and Biology : An abundant littoral and epibenthic shark of the continental and insular shelves and upper slopes down to at least 1200 m. The Greenland shark is one of the larger sharks and by far the largest of Atlantic-Arctic and Antarctic fishes. In the Arctic and boreal Atlantic it occurs inshore in the intertidal and at the surface in shallow bays and river mouths during the colder months but tends to retreat into water 180 to 550 m deep when the temperature rises. At lower latitudes in the North Atlantic (Gulf of Maine and North Sea) it inhabits the continental shelves, and may move into shallower water in the spring and summer. In the southern hemisphere it is found in deepwater (677 m) off South Africa and in 145 to 370 m depth off Kerguelen Island. Water temperatures of places inhabited by these sharks range from 0.6 to 12°C.

This is a proverbially sluggish shark that gives almost no resistance to capture; individuals up to 4.9 m long have been lured to the surface with baits and hauled out of the water with gaffs. It is easily fished through holes in the Arctic ice. In the Arctic summer Greenland sharks usually are close to the bottom but swim up towards the surface for prey.

Development is ovoviviparous; as most females taken are not gravid but have large numbers of large, yolky eggs, it was thought until relatively recently that the Greenland shark might be oviparous. One female 5 m long had 10 young about 37 cm long in 1 uterus; and these were presumably full term because their yolk-sacs were resorbed.

Although seemingly slow-moving, this shark is apparently able to capture large and active prey. Fishes are important food items and include herring, spiny eels, salmon and char, smelt, a variety of gadoids including cod, ling, pollock, and haddock, several flatfish including Atlantic and Greenland halibut, wolf-fish, redfish (*Sebastes*), sculpins, lumpfish, and skates and their egg-cases. The Greenland shark regularly devours marine mammals, including seals (a common prey item, possibly taken alive) and small cetaceans (possibly mostly as carrion); old stories of it attacking living great whales are apparently unfounded. Greenland sharks voraciously devour carrion and offal of all sorts from whaling, sealing, and fishing operations, and will gather to feast in great numbers around whaling stations, whale kills, fish processing operations, and ice flows with skinned seal carcasses. These sharks will glut themselves on such abundance, and seem insensate to blows from clubs or cutting instruments while gorging. Parts of drowned horses and an entire reindeer were found in large Greenland sharks. Other prey includes sea birds, squids, crabs, amphipods, marine snails, brittle stars, sea urchins, and jellyfish.

The Greenland shark has an unusual copepod parasite that attaches itself to the corneas of the eyes; usually only a single copepod is present on each eye. The copepods are highly conspicuous and may even be luminescent; and it has been speculated that their relationship to the shark is mutualistic and beneficial, with the copepods serving as lures to bring prey species in proximity to their hosts. Field observations are necessary, however, to determine if the parasites actually serve as lures.

Despite the great size of this shark and its apparent fondness for mammalian prey it has never been indicted in attacks on people. The Greenland shark is regarded as harmless by fishermen but is considered potentially dangerous by some writers. There are old, unsubstantiated and possibly mythical tales of Greenlanders in kayaks being attacked by these sharks.

Size : Maximum total length at least 640 cm and possibly to 730 cm, but most adults between 244 to 427 cm; adult males reach at least 343 cm, adult females to at least 500 cm. Size at birth uncertain, but probably full-term fetuses were 37 cm long.

Interest to Fisheries : The Greenland shark has long been fished in Greenland, Iceland and northern Norway for its liver oil, but its meat is also used fresh and dried for human and sled-dog food. The meat is toxic when fresh, unless carefully washed, but is harmless dried or semi-putrid. Eskimos have used the skin of the Greenland shark for making boots, and used the sharp lower dental bands as knives for cutting hair.

The Greenland shark is mostly fished with hook-and-line, longline gear or gaffs, but is often taken in seal and whale nets and cod traps.

Literature : Whitley (1939); Bigelow & Schroeder (1948); Norman & Fraser (1949); Bjerkan (1957); Koefoed (1957); Garrick & Schultz (1963); Templeman (1963); Beck & Mansfield (1969); Lineaweaver & Backus (1970); Bass, d'Aubrey & Kistnasamy (1976); Quéro (1976); Duhamel & Hureau (1982).

Remarks : Somniosus antarcticus was named by Whitley (1939) from a sketch and descriptive data from a Somniosus specimen found dead on a beach at Macquarie Island in the Antarctic. The specimen itself was not preserved, but tooth and skin samples were saved; however, it is uncertain whether these samples still exist. The descriptive data and sketch definitely indicate that the specimen represented a number of the subgenus Somniosus closest to S. microcephalus, but these are sufficiently generalized to prohibit the differentiation of S. antarcticus from S. microcephalus. As with certain other sharks, Whitley apparently named S. antarcticus primarily because of its southern hemisphere locality.

Bass, d'Aubrey & Kistnasamy (1976) reported a southern hemisphere Somniosus from South Africa as "S. microcephalus or a closely related species". Duhamel & Hureau (1982) reported several specimens from waters off Kerguelen Island as S. microcephalus. As southern hemisphere Somniosus have never been compared in detail with northern material, identification of these sharks as S. microcephalus must be considered tentative. However, available information does not justify the recognition of S. antarcticus on locality alone, and so this species is here placed as a tentative synonym of S. microcephalus.

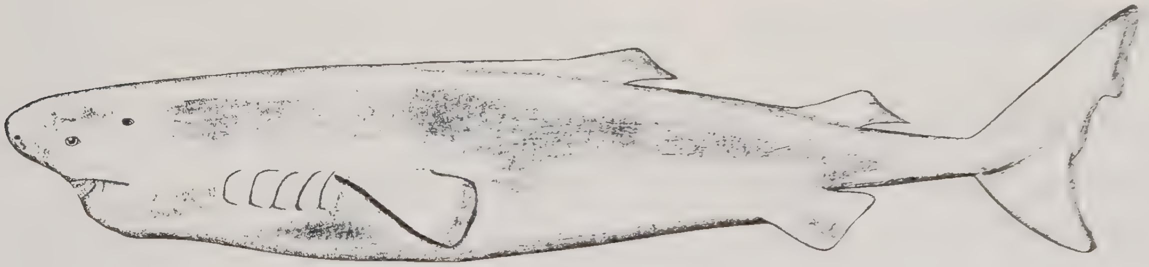
Somniosus pacificus Bigelow & Schroeder, 1944

SQUAL Somn 3

Somniosus pacificus Bigelow & Schroeder, 1944, Proc.New England Zool.Club, 23:35. Holotype : Presumably Museum of Comparative Zoology, Harvard, MCZ, 1910 mm, immature male. Type Locality : Sagami Sea, Japan.

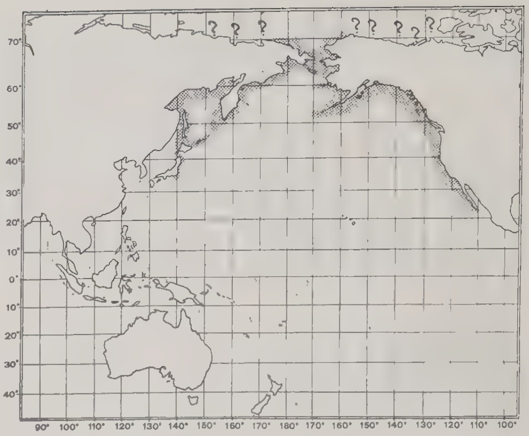
Synonymy : None.

FAO Names : En - Pacific sleeper shark; Fr - Laimargue dormeur; Sp - Tollo negro dormilón.



Field Marks : Short, rounded snout, heavy cylindrical body and small precaudal fins, two spineless, equal-sized dorsal fins, no anal fin, long ventral caudal lobe, first dorsal fin on back closer to pelvics than pectoral fins, interdorsal space less than distance from snout tip to first gill openings, no short keels on base of caudal fin, upper teeth lanceolate, lower teeth with short, low, strongly oblique cusps and high narrow roots.

Diagnostic Features : Head moderately long, length from snout to pectoral fins from 25 to 30% total length in specimens from 106 to 430 cm total length; snout short and broadly rounded; cusps of lower teeth short and low, strongly oblique, roots very high; total tooth rows 35 to 45/53 to 58. Insertion of first dorsal fin closer to pelvic bases than pectoral bases; interdorsal space less than distance from snout tip to first gill slits. No lateral keels present on base of caudal fin. Caudal peduncle short, distance from second dorsal insertion to upper caudal origin 1.8 times second dorsal base or less, distance from pelvic insertions to lower caudal origin less than dorsal caudal margin. Lateral trunk denticles with erect, narrow-crowns and hooked cusps, giving skin a rough, bristly texture. Vertebral column without well-defined calcified centra, notochord secondarily expanded. Size large, exceeding 4.3 m.



Geographical Distribution : North Pacific: Japan along Siberian coast (USSR) to Bering Sea and southward to southern California (USA), and Baja California (Mexico).

Habitat and Biology : A common boreal and temperate shark of the North Pacific continental shelves and slopes. At high latitudes with cold surface waters it ranges into the littoral and even the intertidal (one large individual was found trapped in a tide pool) as well as the surface; however in lower latitudes with temperate water it becomes a deepwater epibenthic shark, never coming to the surface and ranging down to at least 2000 m in the extreme southern end of its range (off southern California and Baja California).

Development is probably ovoviviparous, but pregnant females have yet to be found, and for some reason (such as segregation of pregnant females beyond the usual fisheries gear that captures these sharks or extremely low fecundity with a small fraction of adult females pregnant at any one time) are rare as in the closely related Greenland shark (*S. microcephalus*). However, adult females with up to 300 large eggs have been occasionally taken.

These sharks feed on a wide variety of surface and bottom animals, including flatfishes, Pacific salmon, rockfishes, harbor seals, octopuses, squids, crabs, tritons, and carrion. It is not known if seals and fast-swimming pelagic fish such as salmon are captured alive by these lumbering, sluggish sharks or are picked up as carrion. The small mouths and long heads and oral cavities of these sharks suggest that they are powerful suction feeders, but this has yet to be observed. Pacific sleeper sharks commonly are attracted to traps set at great depths for sablefishes (*Anoplopoma*), and get trapped themselves or else eat catch and bait-can and escape.

Size : Maximum captured and measured an adult female of 430 cm total length, but larger individuals estimated at 7 or more metres long have been photographed in deep water; another adult female was 3.7 m long.

Interest to Fisheries : Unknown.

Literature : Roedel & Ripley (1950); Bigelow & Schroeder (1948, 1957); Bright (1959); Gotshall & Jow (1965); Hart (1973).

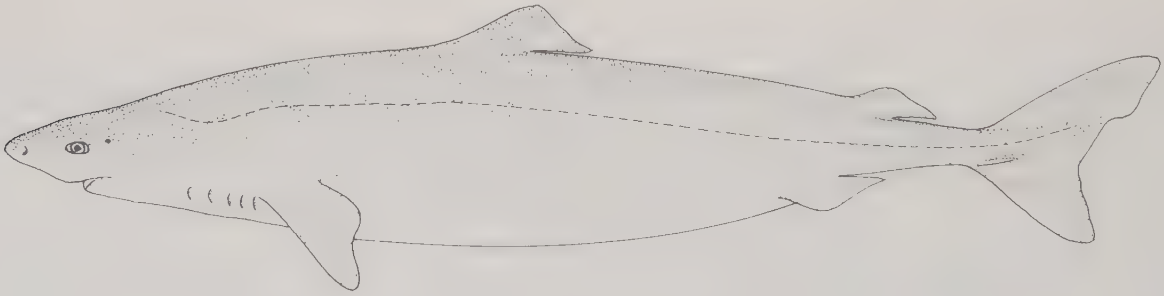
Somniosus rostratus (Risso, 1826)

SQUAL Somn 1

Scymnus rostratus Risso, 1826, *Hist.nat.princip.prod.Europe Mered., Paris, Poissons*, 3:138, pl. 3, fig. 7. Holotype : Unknown. Type Locality : Mediterranean Sea, deep water.

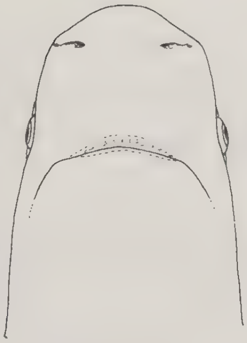
Synonymy : *Heteroscymnus longus* Tanaka, 1912; *Somniosus bauchotae* Quéro, 1976.

FAO Names : En - Little sleeper shark; Fr - Laimargue de la Méditerranée; Sp - Tollo boreal.



Field Marks : Short, rounded snout, two spineless, equal-sized dorsal fins, no anal fin, long ventral caudal lobe, first dorsal fin on back closer to pectorals than pelvic fins, short keels on base of caudal fin.

Diagnostic Features : Head short, length from snout to pectoral fins from 20 to 23% total length in specimens above 70 cm total length; snout short and broadly rounded; cusps of most lower teeth large, high, and semioblique, roots low; total tooth rows 57 to 63/33 to 36. Insertion of first dorsal fin closer to pectoral bases than pelvic bases; interdorsal space equal or greater than distance from snout tip to second gill slits. A short lateral keel present on base of caudal fin. Caudal peduncle short, distance from second dorsal insertion to upper caudal origin 2 times second dorsal base or less, distance from pelvic insertions to lower caudal origin subequal to dorsal caudal margin. Lateral trunk denticles with flat, wide, crowns and horizontal cusps, giving skin a smooth texture. Vertebral column with well-defined centra. Size small, not exceeding 1.4 m.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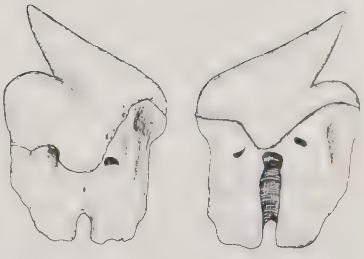
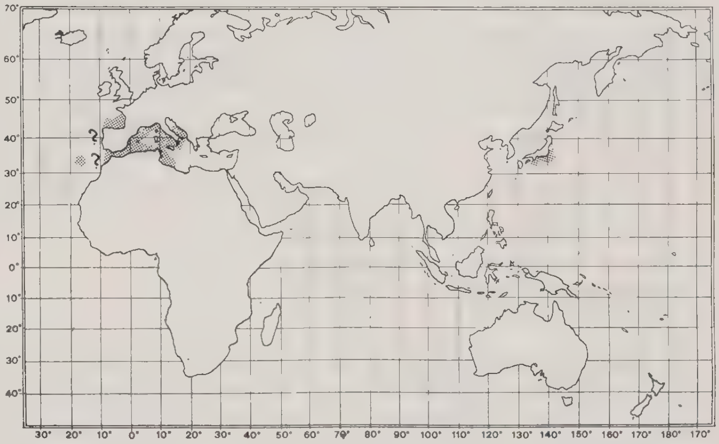


lower tooth

Geographical Distribution : Eastern North Atlantic: Madeira, France; western Mediterranean. Western Pacific: Japan.



Habitat and Biology : A rare to sporadically common, little-known small sleeper shark of the outer continental shelves and upper slopes, occurring on or near the bottom at depths of 200 to 1000 m. Development ovoviviparous. Probably eats deepwater bottom fishes and invertebrates. This species was long thought to have luminous organs, but Fulgosi & Gandolfi (1983) recently showed that the structures in question are really pit organs. Hence this species agrees with the large species of *Somniosus* (subgenus *Somniosus*) in lacking light organs.

Size : Maximum total length about 140 cm; adult males 71 cm; adult females 82 to 134 cm; size at birth between 21 and 28 cm.

Interest to Fisheries : Minimal, caught on longlines and with bottom trawls in the eastern Atlantic and used for fishmeal and possibly for human consumption.

Literature : Bigelow & Schroeder (1948, 1957); Maul (1955); Tortonese (1956); Quéro (1976); Cadenat & Blache (1981); Fulgosi & Gandolfi (1983).

Remarks : I tentatively include the Japanese *Heteroscymnus longus* and the Mediterranean *S. bauchotae* in synonymy of *S. rostratus*. I examined a specimen of the Japanese *longus* and agree with Bigelow & Schroeder (1957) and Quéro (1976) that it is difficult to separate from *S. rostratus*. *S. bauchotae* was separated from *S. rostratus* by its rounded, truncated first dorsal free rear tip, more angular, posteriorly concave pectoral fins (less angular in *S. rostratus*), presence of a lateral keel on the caudal base (supposedly absent in *S. rostratus*), distance from second dorsal origin to lower caudal origin about twice second dorsal base (about equal to it in *S. rostratus*), and in having narrower lower teeth relative to their base heights (bases slightly higher than wide in *S. bauchotae*, *vice versa* in *S. rostratus*). *S. bauchotae* was described from a single specimen, 130 cm long (Quéro, 1976). I suspect that the first dorsal rear tip of the holotype of *S. bauchotae* is abnormally truncated, possibly as the result of damage and subsequent regrowth of the fin tip. The pectoral fin shape, tooth shape, and postdorsal space length characters may be indicative of individual variation rather than species distinction. A caudal keel was pictured on a Mediterranean *S. rostratus* with an elongated first dorsal rear tip, broadly rounded pectoral apices, postdorsal space slightly longer than the second dorsal base, but with tooth bases higher than wide (Tortonese, 1956, fig. 100). A Japanese specimen of *rostratus* on hand with elongated first dorsal rear tip, postdorsal space 1.3 times second dorsal base, nearly straight posterior margins but narrowly rounded apices on its pectoral fins, and lower teeth with bases slightly higher than wide has well developed caudal keels. I suspect that the caudal keels are characteristic of *S. rostratus* but may have been overlooked in some accounts of the species (such as Maul, 1955). A specimen of *S. pacificus* on hand lacks the keels.

After the above remarks were written the writer received the paper of Fulgosi & Gandolfi (1983), which essentially duplicated his conclusions on the validity of *S. bauchotae* and *S. longus*, but based on a number of specimens of *S. rostratus* from the Mediterranean Sea. All of these specimens have the small caudal keels.

Squaliolus Smith & Radcliffe, 1912

SQUAL Squa

Genus : *Squaliolus* Smith & Radcliffe, 1912, *Proc.U.S.Nat.Mus.*, 41(1877):683.

Type Species : *Squaliolus laticaudus* Smith & Radcliffe, 1912, by original designation.

Synonymy : None.

Diagnostic Features : Anterior nasal flaps very short, not expanded into barbels; snout very long, bulbously conical but slightly pointed, length about half head length and about equal to distance from mouth to pectoral fins; gill openings very small, uniformly wide; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, no bladelike, lowers much larger, bladelike, interlocked, with a high, moderately broad, nearly erect cusp and distal blade, edges not serrated; tooth rows 22 to 23/16 to 21. First dorsal fin with a spine, covered by skin or not, but second dorsal without a spine; first dorsal fin well anterior, origin about opposite inner margins or free rear tips of pectoral fins, insertion well anterior to pelvic origins and loser to pectoral bases than pelvics; second dorsal fin much larger than first, base about twice as long as first dorsal base; origin of second dorsal fin over fron half of pelvic bases; pectoral fins with short, narrowly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin nearly symmetrical, paddle-shaped, with a short upper and long lower lobe and a strong subterminal notch. No precaudal pits or midventral keels, but with low lateral keels on caudal peduncle. Dermal denticles flat and blocklike, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca normal, not expanded as a luminous gland. Colour blackish or blackish-brown with conspicuously light-margined fins.

Remarks : The arrangement of this genus follows Seigel *et al.* (1977) and Seigel (1978).

Squaliolus laticaudus Smith & Radcliffe, 1912

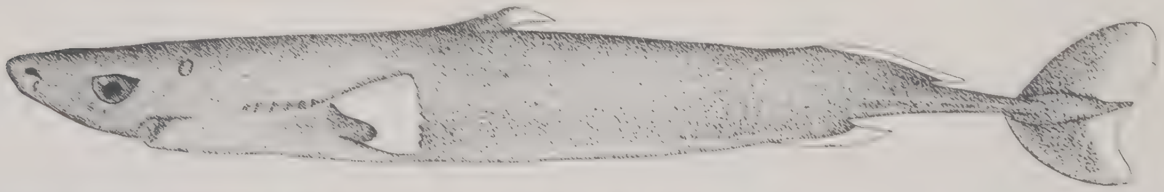
SQUAL Squa 1

Squaliolus laticaudus Smith & Radcliffe, 1912, *Proc.U.S.Nat.Mus.*, 41(1877):684, fig. 4, pls. 50, 54. Holotype : U.S. National Museum of Natural History, USNM 70259, 150 mm adult male. Type Locality : 13°42'N, 120°57.3'E, Batangas Bay, Luzon, Philippines, 311 m depth.

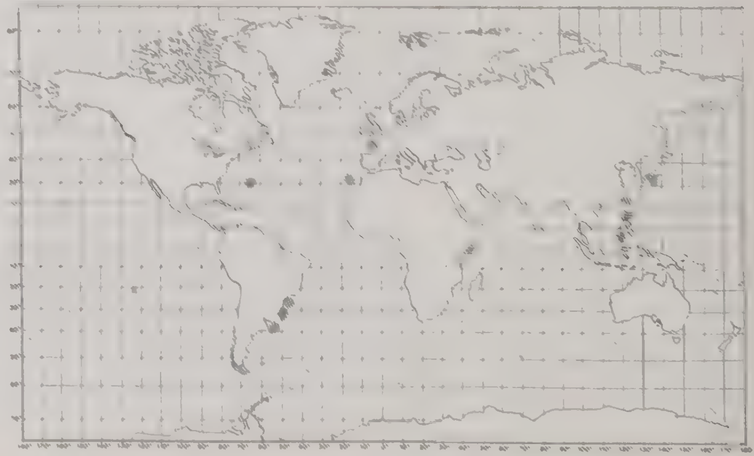
Synonymy : *Squaliolus sarmenti* Noronha, 1926; *Squaliolus alii* Teng, 1959.

Other Scientific Names Recently in Use : *Euprotomicrus laticaudus* (Smith & Radcliffe, 1912).

FAO Names : En - Spined pygmy shark; Fr - Squale nain; Sp - Tollo pigmeo espinudo.



Field Marks : The only shark with a fin spine on its first dorsal but not its second; very small size, spindle-shaped body, long, bulbously conical, pointed snout, second dorsal fin with base about twice as long as that of first, first dorsal fin with origin opposite inner margins or rear tips of pectoral fins, no anal fin, dark colour with conspicuously light-margined fins.



Diagnostic Features : See genus.

Geographical Distribution : Oceanic and nearly circumtropical. Western Atlantic: Off Bermuda, southern Brazil and northern Argentina. Eastern Atlantic: Off France and Madeira. Western Indian Ocean: Off Somalia. Western Pacific: off Japan, Taiwan Island and the Philippines.

Habitat and Biology : A wide-ranging, tropical epipelagic species that occurs near continental and island land masses, sometimes over the shelves, but usually over the slopes at depths from 200 to 500 m. Unlike its relatives *Euprotomicrus bispinatus* and *Isistius* brasiliensis. It apparently avoids the surface and has not been caught at night-light there. It shows vertical migrations on a diel cycle, retreating to the bottom of its depth range during the day and travelling to about 200 m at night. It apparently avoids the central ocean basins far from land, unlike its close relative Euprotomicrus bispinatus, but prefers the edges of land masses in areas of high productivity. These two species, with probably similar feeding capabilities and requirements, are virtually allopatric in distribution, whereas the larger, more powerfully armed, highly specialized and semiparasitic Isistius brasiliensis broadly overlaps both E. bispinatus and Squaliolus laticaudus.

This shark has well-developed photophores, densely covering the ventral surface of the body but sparse on the sides and hardly developed on the dorsal surface. Such photophore patterns in this and other bioluminescent sharks and mesopelagic teleosts has been explained as 'photophore countershading', in which the light-producing underside eliminates the shadow normally formed when the fish is illuminated from above, and hence makes it less conspicuous to potential predators. Development probably ovoviviparous, but embryos have not been obtained. Twelve mature eggs have been found in a single ovary of a mature female, but this does not necessarily imply that large litters are produced.

The spined pygmy shark eats deepwater squid, lanternfish, gonostomatids and idiacanthids, and probably follows its prey on their diel migrations.

Size : Possibly the smallest living shark, although closely rivaled by Eridacnis radcliffei (Family Proscylliidae). Maximum total length about 25 cm, males maturing at about 15 cm and reaching 22 cm, females maturing between 17 and 20 cm and reaching 25 cm.

Interest to Fisheries : None.

Literature : Bigelow & Schroeder (1957); Seigel et al. (1977); Seigel (1978).

Squalus Linnaeus, 1758

SQUAL Squal

Genus : Squalus Linnaeus, 1758, Syst.Nat., ed.10, 1:233.

Type Species : Squalus acanthias Linnaeus, 1758, by subsequent designation of Gill (1862:405).

Synonymy : Genus Squalus Scopoli, 1777; Genus Squalis Radermaker, 1779; Subgenus Acanthorhinus Blainville, 1816 (Genus Squalus Linnaeus, 1758); Genus Acanthias Leach, 1818 (also Risso, 1826); Genus Carcharias Gistel, 1848 (not Rafinesque, 1810, or Cuvier, 1817); Genus Acantias Vaillant 1888 (error); Subgenus Flakeus Whitley, 1939 (Genus Squalus Linnaeus, 1758); Subgenus Koinga Whitley, 1939 (Genus Squalus Linnaeus, 1758).

Field Marks : Short to rather long snout, short anterior nasal flaps, low, bladelike cutting teeth in both jaws, no anal fin, stout, ungrooved fin spines on both dorsal fins, caudal peduncle with lateral keels and usually a precaudal pit, caudal fin without a subterminal notch.

Diagnostic Features : Anterior nasal flaps short, not elongated as barbels; snout flattened, short to very long, and broadly rounded to pointed, length 1/3 to 3/5 of head length and 3/5 to 1 1/3 times distance from mouth to pectoral origins; gill openings moderately broad and about equally wide; lips thin, not pleated or suctorial; teeth similar in both jaws, bladelike, interlocked, with a single oblique cusp and distal blade on a low crown and root, upper teeth slightly smaller than lowers, edges smooth in living species (serrated in some fossils); tooth rows 24 to 29/20 to 26. Both dorsal fins with long, stout, ungrooved spines; first dorsal origin varying from over pectoral bases to slightly posterior to pectoral free rear tips, insertion well anterior to pelvic origins but varying from somewhat closer to the pectoral bases than the pelvics to vice versa; second dorsal fin usually somewhat smaller than first dorsal but up to first dorsal size in one species, base subequal to about 3/4 of first dorsal base; pectoral fins with short to moderately long, narrowly rounded to acutely angular rear tips and inner margins, not greatly elongated or broadly lobated; caudal fin asymmetrical, not paddle-shaped, with a long upper lobe and lower lobe varying from moderately long to very short, subterminal notch absent. Lateral keels and usually precaudal pits present on caudal peduncle, but no midventral keels. Dermal denticles with low, pedicellate, lanceolate or tricusped and tridged, flat, leaf-shaped crowns. Cloaca without a luminous gland. Colour usually grey or grey-brown above, lighter below, fins in some species with conspicuous white or black markings.

Remarks : The arrangement of the genus follows Bigelow & Schroeder (1957), Bass, d'Aubrey & Kistnasamy (1976), and Chen, Taniuchi & Nose (1979).

Key to Species :

1a. Second dorsal fin almost as large as first. Anterior nasal flaps with very large, broad secondary lobe. Upper precaudal pit weak or absent. Postventral caudal margin shallowly concave. Denticles very large, body surface rough .... *S. asper*

1b. Second dorsal fin much smaller than first. Anterior nasal flaps with secondary lobe small and narrow to absent. Upper precaudal pit strong. Postventral caudal margin deeply notched. Denticles small, body surface smooth

2a. Preoral snout elongated, about 1.5 to 2.0 times mouth width, preorbital snout two times eye length or more in adults. Eyes closer to first gill slits than snout tip. Inner corners of nostrils closer to mouth than snout tip

3a. Tips of dorsal fins, dorsal caudal margin and ventral caudal lobe conspicuously black .... *S. melanurus*

3b. Tips of dorsal fins and caudal not conspicuously black

4a. Snout acutely pointed. Secondary lobe well developed on anterior nasal flaps. Ventral caudal lobe long .... *S. japonicus*

4b. Snout narrowly parabolic. Secondary lobe vestigial or absent on anterior nasal flaps. Ventral caudal lobe short .... *S. rancureli*

2b. Preoral snout short to moderately elongated, usually less than 1.4 times mouth width, preorbital snout less than two times eye length in adults. Eyes closer to snout tip than first gill slits. Inner corners of nostrils closer to snout tip than mouth

5a. Origin of first dorsal spine well behind free rear tips of pectorals. Secondary lobe minute or absent on anterior nasal flaps. Usually white spots present on sides .... *S. acanthias*

5b. Origin of first dorsal spine over inner margins of pectorals and usually in front of their rear tips. Secondary lobe well-developed on anterior nasal flaps. No white spots on sides

6a. Diagonal distance from centre of snout tip to inner edge of nostril less than or about equal to distance from nostril to upper labial furrow. Pectoral fins with acutely pointed free rear tips. Lateral trunk denticles lanceolate

7a Fin spines rather long, first dorsal spine nearly equal to fin base. Posterior margin of pectoral fins deeply concave. Midpoint of pelvic bases about midway between first and second dorsal bases .... *S. cubensis*

7b. Fin spines rather short, first dorsal spine much less than fin base. Posterior margin of pectoral fins moderately concave. Midpoint of pelvic bases closer to first dorsal base than second .... *S. megalops*

6b. Diagonal distance from centre of snout tip to inner edge of nostril greater than distance from nostril to upper labial furrow. Pectoral fins with rounded rear tips. Lateral trunk denticles tricuspidate

8a. First dorsal height more than 3/4 of its length from origin to free rear tip, first dorsal spine as long as fin base. Height of second dorsal more than 5% of total length, second dorsal spine usually over 6% of total length .... *S. blainvillei*

8b. First dorsal height less than 2/3 of its length, first dorsal spine much shorter than fin base. Height of second dorsal less than 5% of total length, second dorsal spine less than 6% of total length .... *S. mitsukurii*

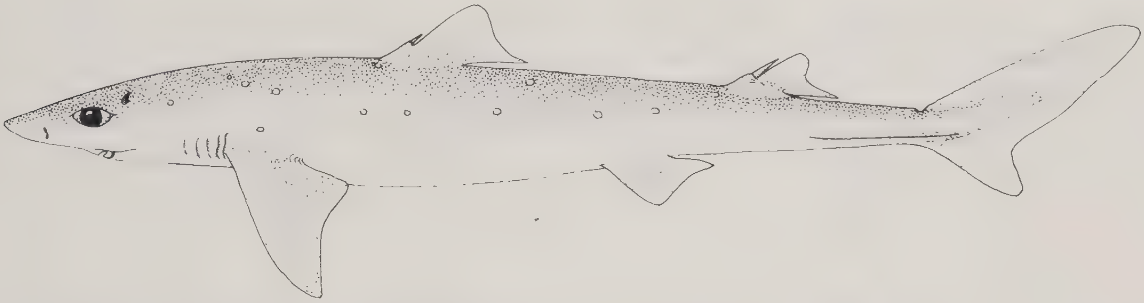
Squalus acanthias Smith & Radcliffe, 1912

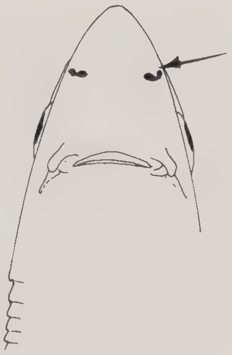
SQUAL Squal 1

Squalus acanthias Linnaeus, 1758, *Syst.Nat.*, ed. 10, 1:233. Holotype : Unknown. Type Locality : "Oceano europaeo".

Synonymy : *Squalus spinax* Olivius, 1780 (not Linnaeus, 1758 = *Etmopterus spinax*); *Squalus fernandinus* Molina, 1782; *Acanthias antiguorum* Leach, 1818; *Acanthias vulgaris* Risso, 1826; *Acanthias americanus* Storer, 1846; *Spinax mediterraneus* Gistel, 1848; *Spinax (Acanthias) suckleyi* Girard, 1854; *Acanthias sucklii* Girard, 1858 (error for *suckleyi* ?); *Acanthias linnei* Malm, 1877; *Acanthias lebruni* Vaillant, 1888; *Acanthias commun* Navarette, 1898; *Squalus mitsukurii* Tanaka, 1917 (not Jordan & Fowler, 1903); *Squalus wakiyae* Tanaka, 1918; *Squalus kirki* Phillips, 1931; *Squalus whitleyi* Phillipps, 1931; *Squalus barbouri* Howell-Rivero, 1936.

FAO Names : En - Piked dogfish; Fr - Aiguillat commun; Sp - Mielga.





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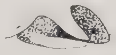
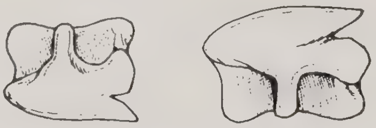
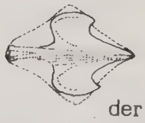


left nostril



upper and lower teeth

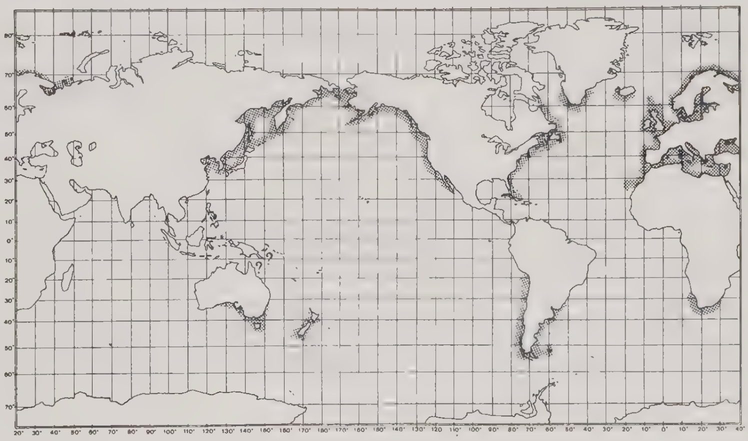


dermal denticle

Field Marks : Two dorsal fins with ungrooved large spines, first dorsal spine origin behind pectoral rear tips, white spots on grey sides, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.

Diagnostic Features : Body fairly slender. Snout subangular, pointed, narrow, and moderately long, diagonal distance from snout tip to excurrent aperture of nostril greater than that from excurrent aperture to upper labial furrow, preoral snout about 1.2 to 1.3 times mouth width, preorbital snout less than twice eye length; eyes about equidistant between snout tip and first gill slits; nostrils nearer snout tip than mouth; anterior nasal flap with posterior secondary lobe minute or absent. First dorsal spine short, much shorter than fin base and with tip falling far below apex of fin; second moderately long, about as high as fin, and less than 5% of total length; first dorsal fin more posteriorly situated, with origin over or behind pectoral free rear tips and spine origin behind tips; first dorsal low, height less than half length from origin to rear tip; second dorsal markedly smaller than first, with height less than 5% of total length; pectoral fins narrow and falcate, posterior margins slightly concave, rear tips narrowly rounded; pelvic midbases closer to second dorsal base than to first; caudal fin narrow-lobed and moderately long, with a long ventral lobe and strongly notched postventral margin. Upper precaudal pit well developed on caudal peduncle. Lateral trunk denticles small, tricuspidate and with deeply scalloped posterior borders in adults. Colour grey above, white below, usually with conspicuous white spots present on sides of body, dorsal and fins without white edges but dusky-tipped in young and plain in adults. Size moderate to large, up to 1.5 m but mostly smaller.

Geographical Distribution : Antetropical. Western Atlantic: Greenland and Labrador (Canada) to Florida (USA), Cuba; Uruguay and Argentina. Eastern Atlantic: Iceland and Murman Coast (USSR) to Morocco, West Sahara, Canary Islands, Mediterranean and Black Sea; Cape coast of South Africa. Western Pacific: Bering Sea to Japan, Sea of Okhots, Republic of Korea and northern China; southern Australia, New Zealand, ? Papua New Guinea. Eastern Pacific: Bering Sea to southern Baja California, possibly Gulf of California; Chile.



Habitat and Biology : An extremely abundant, boreal to warm-temperate, inshore and offshore dogfish of continental and insular shelf waters and the upper slopes, from the surface down to the bottom but usually near the bottom; found from the intertidal down to at least 900 m.

This is possibly the most abundant living shark, despite its restricted range, and the only one that supports fisheries of a size rivaling those of the more commercially important bony fishes. Bigelow & Schroeder (1948) noted that in a time of peak abundance in 1904-1905 an estimated 27 000 000 dogfish were taken off the Massachusetts coast each year. The piked dogfish is probably the best-known of living sharks, particularly from a morphological, experimental and fisheries-biological viewpoint, though its ecological relationships and ethology is far less well known than some other sharks, particularly certain tropical carcharhinids and sphyrnids. Knowledge of its biology clearly reflects the concerns of fisheries and the interests of fisheries biologists, as well as its great abundance, but even with the massive corpus of information available great gaps remain in our knowledge of its biology. The literature on this shark is so enormous that only a small amount of the available information can be presented here.

The existence of differentiated, possibly subspecifically distinct, antetropical populations of this temperate shark with little if any mixing at present probably also allows for considerable variation in biology for different areas. Principle contiguous populations are apparently those of the North Atlantic, eastern South Pacific, eastern South Atlantic coast of South America, Cape coast of South Africa, temperate south coast of Australia, temperate southern New Zealand, and the North Pacific. Some of these larger areas apparently have differentiated stocks or subpopulations with complex migration patterns and possibly limited mixing. The various geographic populations or clusters of populations have been given separate subspecific or specific names, but there is no agreement at present as to which of these should be recognized. The North Pacific piked dogfish has been often distinguished as Squalus suckleyi (or sucklii) or Squalus acanthias suckleyi, but the validity of this is disputed.

The piked dogfish is described as a slow, inactive swimmer, which nevertheless keeps a steady pace in its nomadic, erratic and regular movements. If not greatly traumatized in capture and transportation to holding facilities it can survive for a few years in captivity, provided it is given proper care and an adequate containment. In captivity it swims strongly but slowly; one kept for over a year was seen to occasionally orient itself vertically at the surface and poke its snout and head out of the water. The dogfish forms immense feeding aggregations or packs in rich foraging grounds and may be present in thousands. Longline sets of 700 to 1500 hooks with nearly every hook bearing a dogfish have been reported from the western North Atlantic. Dogfish often occur in schools segregated by size and sex, including those of small juveniles of both sexes in equal numbers, mature males, larger immature females, and large mature females. Mixed schools of adults have also been reported, but at best these are probably less common than segregated schools. These schools are dense and localized in a given area, and move erratically over short periods of time, possibly reflecting pursuit of schooling prey fishes. In general, males occur in shallower water than females, with the exception of large pregnant females. Pregnant females may congregate in enclosed shallow bays like San Francisco Bay in California, and drop their young there. Dogfish are also found as solitary individuals and may also associate with schools or aggregations of other temperate sharks such as the leopard shark (Triakis semifasciata) and the brown smoothhound (Mustelus henlei) in the eastern North Pacific.

Although the piked dogfish is often found in enclosed bays and estuaries, and can tolerate brackish water, it apparently cannot survive freshwater for more than a few hours and does not occur there. During the rainy winter and spring of California dogfish may leave San Francisco Bay and other shallow bays and estuaries as the salinity drops, but return in late spring and summer.

Much has been written of the seasonal, bathymetric, and localized movements of this shark. An important correlate of dogfish movements seems to be water temperature; the sharks favour a temperature range with a minimum of 7 to 8^{0}C and a maximum of 12 to 15^{0}C, and apparently make latitudinal and depth migrations to stay within their optimum range. Thus in the western North Atlantic dogfish move inshore from their wintering grounds in deep water off the US Middle Atlantic and southern States as the water warms in spring, pressing northward along the coasts of Newfoundland and Labrador, Canada, and southward along the US Atlantic coast occasionally to Cuba. As the water warms in the south over the optimum in late spring and summer, the dogfish apparently retreat into deepwater, reappear coastally in autumn as the water temperature descends to optimum, and disappear into deep water when the surface temperature goes below optimum. In the northern part of their range in the western North Atlantic large females appear first inshore, followed by adult males. There may be unseasonal invasions of dogfish inshore during the winter for unknown reasons.

Tagging studies off the British Isles suggests separate winter migrations of stocks to the Irish Sea and the Norwegian coast and a return and mixing of these stocks on fishing grounds northwest of the British Isles in summer. Tagging studies in Puget Sound and adjacent areas in the Canadian eastern North Pacific suggest that the dogfish in the Sound itself and the adjacent Strait of Georgia are year-round residents with local internal movements, but the Sound and Strait sharks form separate stocks or subpopulation with little mixing with each other or with seasonally migrating offshore dogfish. Discovery of largely resident and seasonally migrating dogfish groups has also occurred off the US States of Washington and California. Some tagged sharks in the eastern North Pacific have made spectacularly long net movements, in one case a 6500 km movement to Honshu, Japan where the shark was captured seven years after it was tagged off Washington State. Long-range movements have also been reported in the western North Atlantic, up to at least 1600 km.

An ovoviviparous shark, with litters of 1 to 20 young. There is much regional variation in reported litter sizes that may be correlated with other factors than maternal size, but in general larger mother sharks have larger litters of fetuses that attain a larger size before birth than smaller ones. The gestation period is variously reported as 18 to 24 months, and may differ in areas. Mating of dogfish may occur in the winter. Birth in the dogfish may occur primarily during the cold months of the year, with considerable variation and with some young produced in spring and summer. The sex ratio at birth is 1:1. Young are delivered head first with a series of rhythmic contractions reminiscent of birth in mammals.

Age of piked dogfish is commonly determined by counting annual growth rings on the fin spines, though wear of the spines in large dogfish may limit the usefulness of this method. This is apparently a slow-growing and maturing species, that is very long-lived. Ages at maturity may vary regionally, and has been variously reported as 10 to 20 years for females and 11 or more years for males. Ketchen (1975), trying a variety of methods on British Columbian dogfish estimated an average of 14 years to maturation for males and 23 years for females. Maximum age is at least 25 to 30 years, with some estimates going much higher and approaching 100 years.

This shark is a powerful, voracious predator that feeds primarily on bony fishes, and is capable of dismembering rather large prey with its strong jaws and clipper-like teeth. Its bony fish prey includes herring, sardines, menhaden and other clupeids, true smelt (Osmeridae) and their eggs, hake, cod, pollock, ling, haddock and other gadoids, midshipmen, blennies, sand lances, mackerels, porgies, croakers, flatfishes and sculpins. It is thought to prey on most available bony fishes smaller than itself, and will often prey heavily on abundant schooling fishes, but newborn dogfish attack herring larger than themselves, as may adults with cod and haddock. They often destroy fish on longlines and in seines. Cartilaginous fishes are uncommonly taken by dogfish, with the occasional exception of ratfish (Hydrolagus colliei) off Washington State, USA. Their invertebrate prey include squids, octopuses, crabs, shrimps, amphipods, euphausiid shrimps, worms, sea snails, polychaetes, and even sea cucumbers, jellyfishes and comb jellies. In the western North Atlantic these sharks may feed very little in the winter on their deepwater wintering grounds as judged by their thinness when they return to shallow water.

This is not a 'dangerous' species in the sense of attacking people in the water, but is a hazard to those who catch it because of its sharp teeth and toxic fin spines. The piked dogfish can curl itself and whip its tail about to inflict wounds with the long, sharp, second dorsal spine. The toxin is mildly irritating to most people, but some people can have a strong allergenic reaction to it and require hospital care. The main impact of this shark on people is economic, however: both negative, as it displaces or chases off other fishes, gets hooked or netted in gear intended for other species, damages fishing gear, and destroys hooked and netted fishes; and positive, as a fisheries species. Suggestions have been made to 'control' the numbers of dogfish in the western North Atlantic, by a variety of sometimes bizarre methods, though the necessity of doing this is largely a result of prejudice against dogfish as human food and unreasoned hatred for these sharks. However, this is disappearing, and developing fisheries may eventually require restrictions as western North Atlantic dogfish stocks are depleted like heavily exploited European stocks. The high standing populations of this shark may suggest a limitless resource to some, but the low fecundity, long gestation period, long life, and slow maturation of the piked dogfish belies this.

Apart from human beings, this shark is preyed on by a number of larger sharks, some bony fishes, seals and killer whales.

Size : May exceptionally reach 160 cm in the eastern north Pacific, but most individuals there are smaller, and other populations apparently reach smaller maximum sizes. Size of males at maturity from 59 to 72 cm and maximum size of mature males from 83 to 100 cm; size of females at maturity from 70 to 100 cm and maximum size of mature females from 101 to 124 cm; size of young at birth 22 to 33 cm.

Interest to Fisheries : This is one of the most important sharks because of its abundance in colder waters, utilization in various fisheries, and damage it does to gear and catches of other fishes. It is heavily fished in the eastern North Atlantic at least 34 288 metric tons listed by species name in the 1978 FAO fisheries catch statistics for Europe, plus an uncertain tonnage of the species listed under "dogfish sharks" that primarily includes this species but may also include Scyliorhinus species), less so in Canadian, US, New Zealand, Japanese and Korean waters, and no doubt fished elsewhere where it occurs. It is captured primarily in bottom trawls and with line gear (handlines and longlines set near the bottom), but also commonly taken in gillnets; it is also readily captured by sportsfishing gear. It is utilized fresh, fresh frozen, smoked, boiled marinated, dried salted, and in the form of fish cakes for human consumption; it is also utilized in liver oil, pet food, fishmeal, fertilizer and leather.

Literature : Garman (1913); Fowler (1941); Bigelow & Schroeder (1948, 1957); Garrick (1960); Templeman (1963); Jensen (1966); Hart (1973); Ketchen (1975); Bass, d'Aubrey & Kistnasamy (1976).

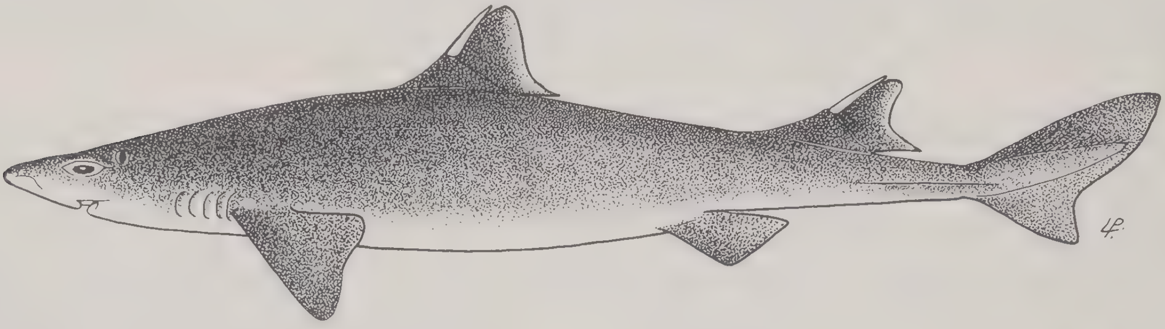
Squalus asper Merrett, 1973

SQUAL Squal 5

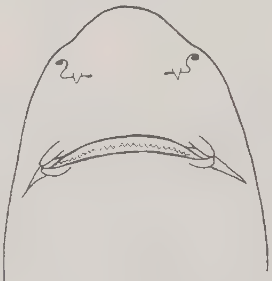
Squalus asper Merrett, 1973, J.Zool., Proc.Zool.Soc.Lond., 171(1):94, fig. 1-4, pl. 1b. Holotype : British Museum (Natural History), BMNH 1972.10.10.2, 850 mm adult male. Type Locality : Indian Ocean, off Aldabra Island, 09°27'S, 46°23.5'E, 219 m depth.

Synonymy : None.

FAO Names : En - Roughskin spurdog; Fr - Aiguillat à peau rugueuse; Sp - Galludo raspa.



Field Marks : Two dorsal fins with ungrooved, very large spines, heavy body and rounded broad snout, first dorsal spine origin behind pectoral rear tips, no spots on sides but white-edged fins, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, upper precaudal pit variably reduced or absent, and lateral keels on caudal peduncle.



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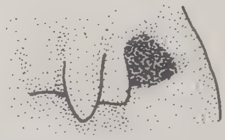
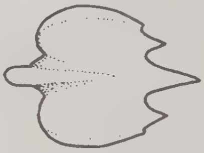


left nostril



dermal denticle

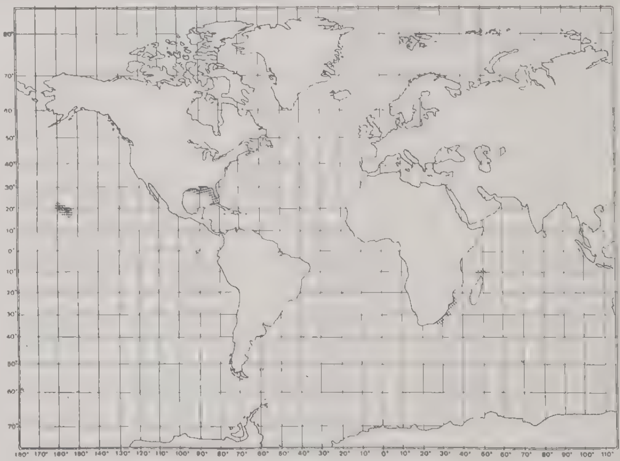
Diagnostic Features : Body stout. Snout rounded-parabolic, broad, and moderately long, diagonal distance from snout tip to excurrent aperture of nostril slightly less than that from excurrent aperture to upper labial furrow, preoral snout about 0.8 to 1.1 times mouth width, preorbital snout less than twice eye length; eyes slightly nearer snout tip than first gill slits; nostrils nearer snout tip than mouth; anterior nasal flap with very large posterior secondary lobe that is usually as broad as distance from its base to inner end of nostrils. First dorsal spine usually moderately long, about half fin base and with tip falling somehwat below apex of fin or reaching it; second long, about as high as fin, and over 6% of total length; first dorsal fin more posteriorly situated, with fin origin opposite or well behind pectoral rear tips and spine origin well behind tips; first dorsal fairly low, height about half length from origin to rear tip; second dorsal about as large as first, with height over 5% of total length; pectoral fins broad and triangular, posterior margins nearly straight, rear tips broadly rounded; pelvic midbases much closer to second dorsal base than first; caudal fin rather broad-lobed and short, with short ventral lobe and moderately concave postventral margin. Precaudal pits weak or absent. Lateral trunk denticles unusually large and tricuspidate and with moderately scalloped posterior borders in adults. Colour dark grey or brown above, lighter below, without white spots on sides of body but with dorsal fins, caudal, and pectorals with conspicuous white edges. Size large, up to nearly 1.2 m.

Geographical Distribution : Western North Atlantic: Northern Gulf of Mexico. Western Indian Ocean: South Africa, southern Mozambique, Aldabra Island group. Central Pacific: Hawaiian Islands.

Habitat and Biology : A little-known but very distinctive spiny dogfish of the upper continental and insular slopes, on or near the bottom, at depths of 214 to 600 m. Ovoviviparous, with large litters (for a spiny dogfish) of 21 to 22 young. Eats bony fish and squid.

Size : Maximum total length 118 cm; adult males 85 to 90 cm and adult females 89 to 118 cm; size at birth about 25 to 28 cm.

Interest to Fisheries : None at present.



Literature : Merrett (1973); Bass, d'Aubrey & Kistnasamy (1976); S. Springer (pers. comm.).

Remarks : Gulf of Mexico and Hawaiian records of the species from S. Springer (pers.comm.).

Squalus blainvillei (Risso, 1826)

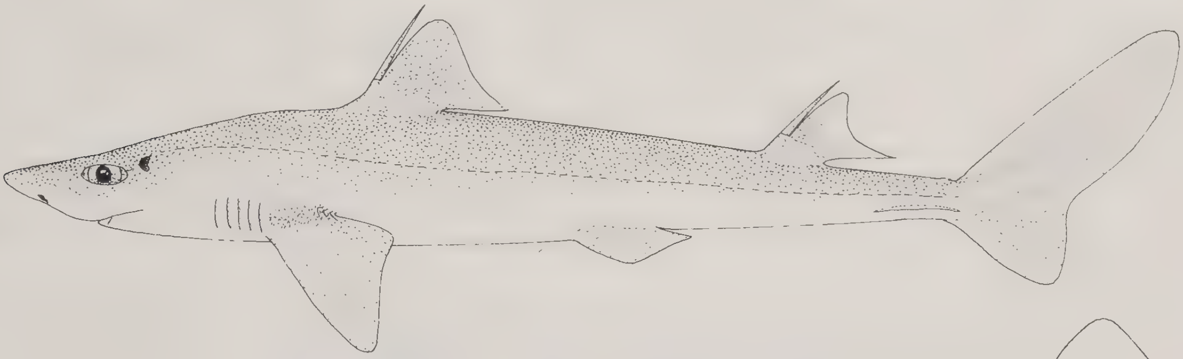
SQUAL Squal 3

Acanthias blainville Risso, 1826, Hist.nat.Princip.prod.Europe Méréd., Paris, Poissons, 3:133, pl. 3, fig. 6. Plate legend, p. 478, has variant spelling Acanthias blainvillii, used by many subsequent writers. Holotype : Unknown. Type Locality : Off Nice, France, Mediterranean Sea.

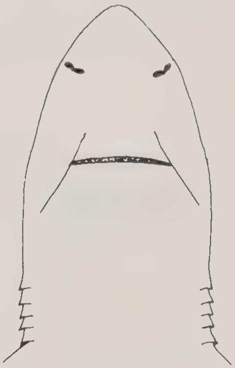
Synonymy : ? Spinax fernandezianus Guichenot, in Gay, 1846 (identity uncertain)

Other Scientific Names Recently in Use : Squalus fernandinus Molina, 1782 (= Squalus acanthias Linnaeus, 1758); Squalus blainvillii or S. blainvillei (variant spellings of S. blainville).

FAO Names : En - Longnose spurdog; Fr - Aiguillat coq (= Aiguillat galludo); Sp - Galludo.

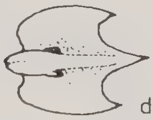


Field Marks : Two dorsal fins with ungrooved, very large spines, first dorsal fin height over 3/4 of its length from origin to base. First dorsal spine origin over pectoral inner margins, long prenarial snout with distance from tip to inner nostril greater than distance from nostril to upper labial furrow, tricuspidate lateral denticles, no white spots, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.



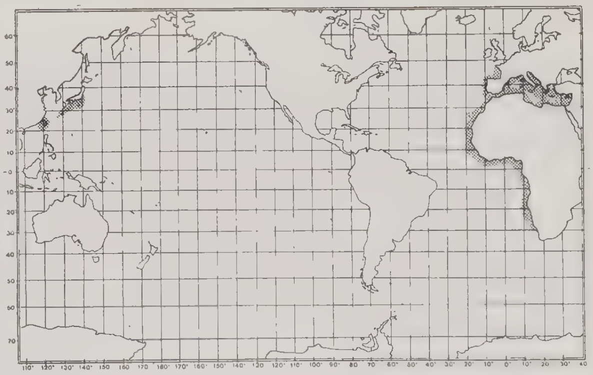
underside of head

Diagnostic Features : Body fairly stout. Snout parabolic-rounded, broad, and moderately long, diagonal distance from snout tip to excurrent aperture of nostril greater than that from excurrent aperture to upper labial furrow, preoral snout about 1.0 to 1.3 times mouth width, preorbital snout less than twice eye length; eyes nearer the snout tip that the first gill slits; nostrils closer to snout tip than mouth; anterior nasal flap with posterior secondary lobe rather large, though somewhat narrower at base than distance from its base to inner corner of nostril. First dorsal spine long, nearly or quite as long as fin base and with tip falling a short distance below apex of fin; second spine very long, slightly higher than fin, and usually more than 6% of total length; first dorsal fin more anteriorly situated, with fin origin about over pectoral insertions and spine origin over pectoral inner margins and well in front of their rear tips; first dorsal very high, height over 3/4 its length from origin to rear tip; second dorsal markedly smaller than first, but with height more than 6% of total length; pectoral fins broad and semifalcate, posterior margins slightly concave, rear tips narrowly rounded; pelvic midbases about equidistant between first and second dorsal bases; caudal fin narrow-lobed and long, with long ventral lobe and strongly notched postventral margin. Precaudal pits strong. Lateral trunk denticles tricuspidate and with weakly scalloped posterior borders in adults. Colour: no white spots present on sides of body, dorsal fins with white edges, caudal without dark markings. Size moderate, up to about 1 m.



dermal denticle

Geographical Distribution : Eastern Atlantic: Bay of Biscay to Mediterranean, Morocco, Canaries, Senegal to Namibia (may include other species in addition to S. blainvillei). Western Pacific: Southern Japan and Taiwan Island. Nominal records of S. blainvillei or S. fernandinus from the western Atlantic (northern Carolina to northern Gulf of Mexico (USA); Argentina), Indian Ocean (South Africa, Mozambique, Madagascar, Tanzania and India), western Pacific (Australia, New Zealand, New Caledonia), central Pacific (Hawaiian Islands), and eastern Pacific (northern Chile), as well as some records from the western North Pacific and eastern Atlantic, are based at least in part on S. mitsukurii and possibly other species. Whether S. blainvillei itself is as wide-ranging as reported for blainvillei-group dogfishes (including S. mitsukurii) remains to be determined.



Habitat and Biology : A common temperate to tropical dogfish of the continental shelves and upper slopes, at or near the bottom at depths of 16 to at least 440 m and probably deeper; often found in large schools. Off West Africa caught on muddy bottom in water of 11 to 18°C and salinities of 36 ppt (16 to 255 m depth). Ovoviviparous, number of young 3 to 4 per litter. Eats a variety of bony fishes, including denticids, mackeral, and percichthyids, as well as crabs, lobsters, and octopi.

Size : Maximum total length at least 95 cm; males about 50 cm at maturity, females about 60 cm at maturity; young born at about 23 cm.

Interest to Fisheries : Common in the temperate to tropical eastern Atlantic and Mediterranean and fished there with bottom trawls, gillnets and line gear. Utilized fresh, dried salted and smoked for human consumption.

Literature : Bigelow & Schroeder (1948, 1957); Poll (1950); Cadenat (1957); Chen, Taniuchi & Nose (1979).

Remarks : Limits to this species are adopted from Chen, Taniuchi & Nose (1979), and species formerly included as possible synonyms of S. blainvillei are listed elsewhere under S. mitsukurii and S. japonicus.

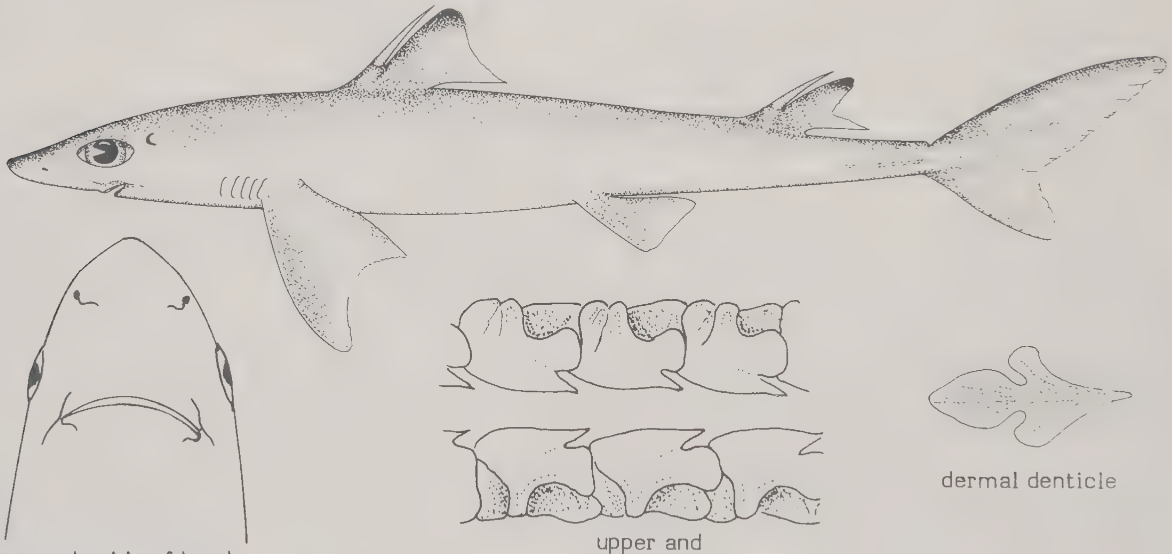
Squalus cubensis Howell-Rivero, 1936

SQUAL Squal 2

Squalus cubensis Howell-Rivero, 1936, Proc.Boston Soc.Nat.Hist., 41(4):45, pls.10 and 11. Holotype : Museum of Comparative Zoology, Harvard, MCZ 1458, 524 mm adult male. Type Locality : Havana, Cuba.

Synonymy : None.

FAO Names : En - Cuban dogfish; Fr - Aiguillat cubain; Sp - Galludo cubano.



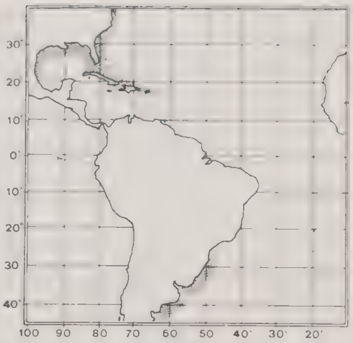
underside of head

upper and
lower teeth

dermal denticle

Field Marks : Two dorsal fins with ungrooved large spines, first dorsal spine origin in front of pectoral rear tips, first dorsal spine about as long as dorsal fin base, pectoral fins falcate and with angular free rear tips and deeply concave posterior margins, no white spots on sides, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.

Diagnostic Features : Body fairly slender. Snout subangular, slightly pointed, fairly broad, and moderately long, diagonal distance from snout tip to excurrent aperture of nostril much less than that from excurrent aperture to upper labial furrow, preoral snout about 1.3 to 1.4 times mouth width, preorbital snout less than twice as long as eye length; eyes considerably closer to snout tip than first gill slit; nostrils much closer to snout tip than mouth; anterior nasal flap with a small posterior secondary lobe, much narrower than space between its base and inner end of nostril. First dorsal spine long, nearly equal to fin base and with tip reaching nearly to apex of fin; second long, about as high as fin, and less than 6% of total length; first dorsal fin anteriorly situated, with fin origin just behind pectoral insertions and spine origin over their inner margins and well in front of their rear tips; first dorsal moderately high, height about half length from origin to rear tip; second dorsal markedly smaller than first, with height less than 6% of total length; pectoral fins fairly wide but strongly falcate, posterior margins deeply concave, rear tips angular and pointed; pelvic midbases about equidistant between first and second dorsal bases; caudal fin narrow-lobed and moderately long, with a long ventral lobe and strongly notched postventral margin. Precaudal pits well-developed. Lateral trunk denticles small, lanceolate and unicuspidate in adults. Colour: grey above, lighter below, without spots, dorsal fins with black tips and pectorals, pelvics and caudal with white edges. Size moderate, usually less than 1 m.



Geographical Distribution : Western Atlantic: North Carolina to Florida (USA), Cuba, Hispanola, northern Gulf of Mexico (Mexico to Florida); southern Brazil, Argentina.

Habitat and Biology : A common offshore warm-temperate and tropical shark of the outer continental shelf and uppermost slopes, found on or near the bottom in large, dense schools at depths between 60 and 380 m; young occur in shallower water than adults. Ovoviviparous, number of young about 10 per litter. Has an unusual huge isopod parasite that lives in its buccal cavity. Probably eats bottom fishes and invertebrates.

Size : Maximum total length possibly to 110 cm, common to 75 cm and maturing at 50 cm or less.

Interest to Fisheries : Taken in commercial bottom trawls primarily in the northern Gulf of Mexico and fished for its liver, which yields oil and vitamins. Seldom utilized for food.

Literature : Bigelow & Schroeder (1948, 1957); Compagno & Vergara (1978); Sadowsky & Moreira (1981).

Squalus japonicus Ishikawa, 1908

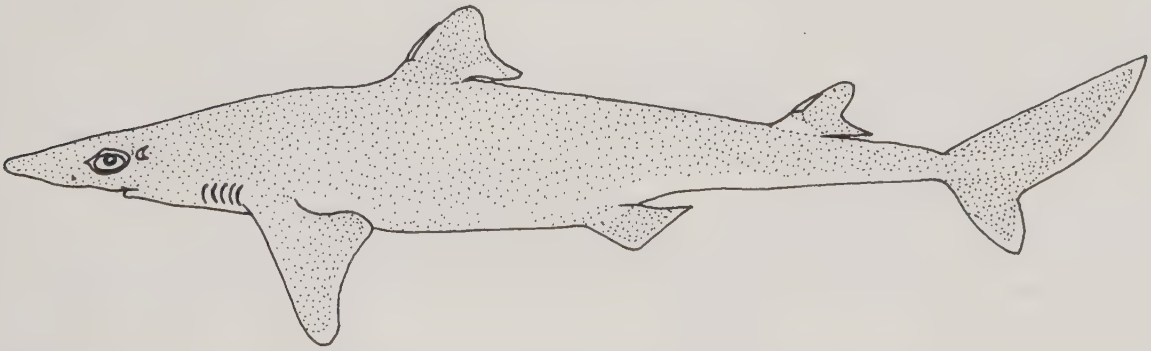
SQUAL Squal 7

Squalus japonicus Ishikawa, 1908, Proc.Acad. Nat.Sci.Philad., 60:71. Holotype : Types not named and apparenlty not extant (see Chen, Taniuchi & Nose, 1979). Type Locality : Ishikawa (1908) mentioned three specimens, 2 from Tokyo Market and apparently from the Sagami Sea, and one from Kagoshima, Japan, on which he based his description of S. japonicus and deposited in the National Science Museum, Japan.

Synonymy : None.

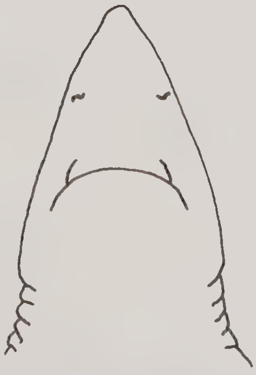
Other Scientific Names Recently in Use : Squalus mitsukurii Jordan & Snyder, in Jordan & Fowler, 1903; Squalus fernandinus Molina, 1782 (= Squalus acanthias Linnaeus, 1758)

FAO Names : En - Japanese spurdog; Fr - Aiguillat togari; Sp - Galludo japones.



Field Marks : Two dorsal fins with ungrooved, large spines, first dorsal fin height less than 2/3 of its length from origin to base. First dorsal spine origin over pectoral inner margins, long, very angular prenarial snout with distance from tip to inner nostril greater than distance from nostril to upper labial furrow, tricuspidate lateral denticles, no white spots, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.

Diagnostic Features : Body fairly slender. Snout angular, broad-based but narrow-tipped, and very long, diagonal distance from snout tip to excurrent aperture of nostril greater than that from excurrent aperture to upper labial furrow, preoral snout about 1.5 to 1.9 times mouth width, preorbital



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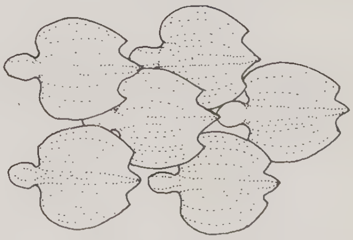
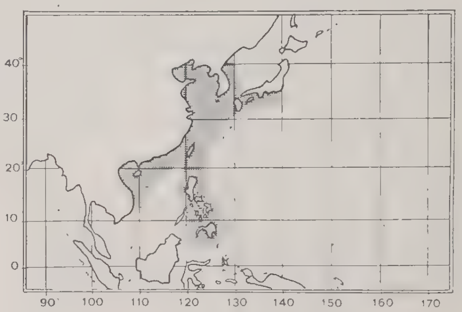


dermal denticles

snout at least twice eye length; eyes closer to first gill slits than snout tip; nostrils closer to mouth than snout tip; anterior nasal flap with posterior secondary lobe small and considerably narrower at base than distance from its base to inner corner of nostril. First dorsal spine moderately long, much less than fin base and with tip falling well below apex of fin; second spine long, slightly lower than fin, and usually less than 6% of total length; first dorsal fin anteriorly situated, with fin origin over pectoral inner margins and spine origin over or slightly behind pectoral rear tips; first dorsal fairly low, height slightly less than 2/3 of its length from origin to rear tip; second dorsal markedly smaller than first, with height less than 5% of total length; pectoral fins broad and semifalcate, posterior margins slightly concave, rear tips narrowly rounded; pelvic midbases about equidistant between first and second dorsal bases; caudal fin narrow-lobed and long, with long ventral lobe and strongly notched postventral margin. Precaudal pits strong. Lateral trunk denticles tricuspidate and with weakly scalloped posterior borders in adults. Colour: no white spots present on sides of body, dorsal fins with white edges, caudal without dark markings. Size moderate, up to slightly less than 1 m.

Geographical Distribution : Western North Pacific: Southeastern Japan and East China Sea, including the Republic of Korea and the Philippines.



Habitat and Biology : A common but little known temperate and tropical dogfish of the outer continental and insular shelves and uppermost slopes at 150 to 300 m depth, presumably on or near bottom.

Size : Maximum total length 91 cm, females mature at 79 cm.

Interest to Fisheries : Apparently common in its range and taken in fisheries off Japan, but details not available.

Literature : Fowler (1941); Chen, Taniuchi & Nose (1979).

Remarks : This species is usually synonymized with S. mitsukurii or S. fernandinus, but is recognized here following Chen, Taniuchi & Nose (1979).

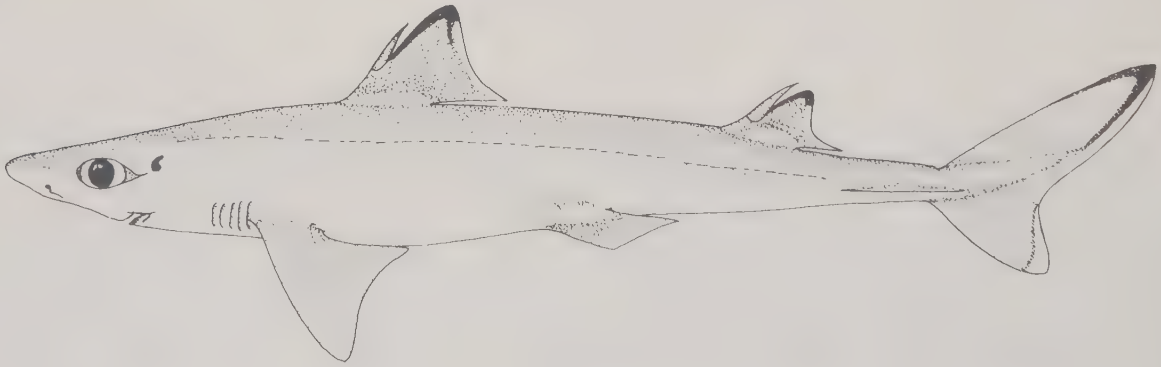
Squalus megalops (Macleay, 1881)

SQUAL Squal 4

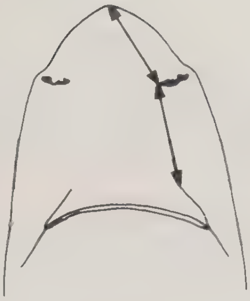
Acanthias megalops Macleay, 1881, Rec.Australian Mus., 4:33, pl. 4, fig. 2. Holotype : Australian Museum, Sydney. Type Locality : Port Jackson, Australia.

Synonymy : ? Squalus brevirostris Tanaka, 1912; Squalus acutipinnis Regan, 1921.

FAO Names : En - Shortnose spurdog; Fr - Aiguillat nez court; Sp - Galludo ñato.



Field Marks : Two dorsal fins with ungrooved large spines, first dorsal spine origin in front of pectoral rear tips, first dorsal spine somewhat shorter than dorsal fin base, pectoral fins falcate and with angular free rear tips and moderately concave posterior margins, no white spots on sides, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.



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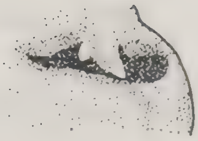
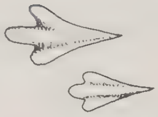


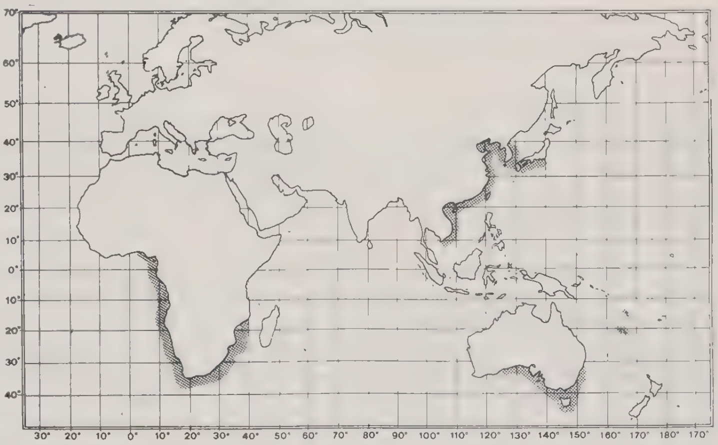
left nostril



dermal denticles

Diagnostic Features : Body fairly slender. Snout subangular, slightly pointed, fairly broad, and moderately long, diagonal distance from snout tip to excurrent aperture of nostril much less than that from excurrent aperture to upper labial furrow, preoral snout about 1.3 to 1.4 times mouth width, preorbital snout less than twice eye length in adults; eyes closer to snout tip than first gill slits; nostrils closer to snout tip than mouth; anterior nasal flap with a small posterior secondary lobe, much narrower than space between its base and inner end of nostril. First dorsal spine moderately long, about half fin base and with tip falling short of apex of fin; second spine long, somewhat higher than fin, but less than 6% of total length; first dorsal fin anteriorly situated, with fin origin just behind pectoral insertions and spine origin over their inner margins and well in front of their rear tips; first dorsal moderately high, height about half length from origin to rear tip; second dorsal markedly smaller than first, with height less than 6% of total length; pectoral fins fairly wide but falcate, posterior margins moderately concave, rear tips angular and pointed; pelvic midbases closer to first dorsal base than second; caudal fin narrow-lobed and moderately long, with a long ventral lobe and strongly notched postventral margin. Precaudal pits well-developed. Lateral trunk denticles small, lanceolate and unicuspidate in adults. Colour: grey or dark brown above, lighter below, without spots, dorsal fins with black tips and white edges but these are often inconspicuous in adults. Size small, usually less than 70 cm.

Geographical Distribution : Eastern Atlantic and western Indian Ocean: Guinea, Gabon to Namibia, South Africa, Mozambique. Western Pacific: Japan, the Koreas, China, Viet Nam; Australia (South Australia, Victoria, Tasmania), New Caledonia and New Hebrides.



Habitat and Biology : A common to abundant small dogfish of temperate and tropical seas, found on the outer continental shelves and upper slopes on or near the bottom at depths of 50 to 732 m. Often forms large, dense schools where it occurs. On the east coast of South Africa some sexual segregation may occurs, with breeding females more southerly in distribution. Ovoviviparous, with number of young per litter 2 to 4 and generally 3. Off South Africa most young are born in the fall or early winter, and mating takes place in the early winter. The gestation period is thought to be about two years.

Eats a variety of bony fishes, including lanternfishes, star-eaters (Astronesthes), snake and conger eels, scorpion fishes, as well as shrimps and other crustaceans, cephalopods, and other elasmobranchs. Off South Africa bony fishes predominated in stomach contents (40%), followed by cephalopods (21%), crustaceans (19%), and other elasmobranchs (1%).

Size : Maximum total length about 71 cm, males maturing at about 40 to 42 cm, females at 53 to 57 cm and reaching 71 cm.

Interest to Fisheries : This shark is often very abundant where it occurs, and is taken in considerable quantities in bottom trawls. It is utilized for human consumption, either fresh or dried salted or smoked.

Literature : Whitley (1940); Fowler (1941); Bass, d'Aubrey & Kistnasamy (1976); Fourmanoir & Rivaton (1979).

Remarks : Squalus brevirostris Tanaka, 1912, from the western North Pacific, is often considered separate from S. megalops, but the validity of this is uncertain at present.

Squalus melanurus Fourmanoir & Rivaton, 1979

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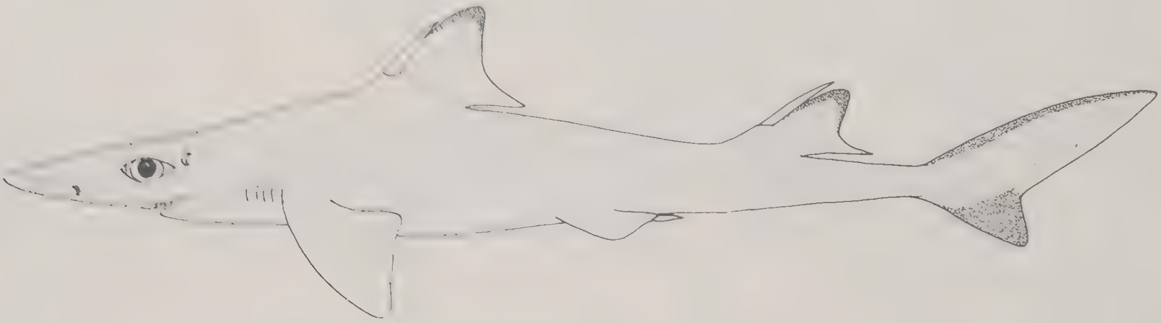
Squalus melanurus Fourmanoir & Rivaton, 1979, *Cah. Indo-Pacifique*, (4):438, fig. 27. Holotype : Muséum National d'Histoire Naturelle, Paris, MNHN 1980-460, 650 mm male, presumably adult. Type Locality : New Caledonia.

Synonymy : None.

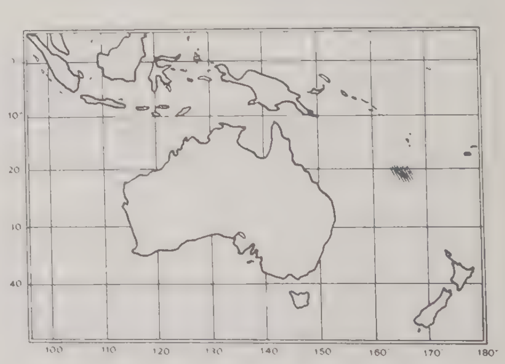
FAO Names : En - Blacktailed spurdog; Fr - Aiguillat à queue noire; Sp - Galludo cola negra.



Field Marks : Two dorsal fins with ungrooved large spines, first dorsal spine origin in front of pectoral rear tips, snout rounded-parabolic and extremely long, preoral snout about twice mouth width, conspicuous black tips on pectoral fins, black dorsal caudal margin, and black ventral caudal lobe, no white spots on sides, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.

Diagnostic Features : Body fairly slender. Snout narrowly parabolic, narrow, and very long, diagonal distance from snout tip to excurrent aperture of nostril greater than that from excurrent aperture to upper labial furrow, preoral snout about 2.3 times mouth width, preorbital snout over twice eye length; eyes much closer to first gill slits than snout tip; nostrils closer to mouth than snout tip; anterior nasal flap with posterior secondary lobe small and considerably narrower at base than distance from its base to inner corner of nostril. First dorsal spine long, about 2/3 of fin base and with tip falling somewhat below apex of fin; second spine long, slightly higher than fin, and over 6% of total length; first dorsal fin anteriorly situated, with fin and spine origins over pectoral inner margins; first dorsal fairly high, height slightly over 3/4 of its length from origin to rear tip; second dorsal markedly smaller than first, but with height more than 5% of total length; pectoral fins probably semifalcate and with narrowly rounded rear tips; pelvic midbases about equidistant between first and second dorsal bases; caudal fin narrow-lobed and long, with long ventral lobe and strongly notched postventral margin. Precaudal pits strong. Lateral trunk denticles tricuspidate and with weakly scalloped posterior borders in adults. Colour: no white spots on body, dorsal fin tips, dorsal caudal margin, and entire ventral caudal lobe conspicuously black. Size moderate, up to 75 cm.

Geographical Distribution : Known only from New Caledonia, from the Uatio and Bulari passes.



Habitat and Biology : A little known, very distinctive long-nosed dogfish from the insular slopes of New Caledonia, at depths of 320 to 340 m. Probably ovoviviparous; a single fetus was present in one female specimen. Eats lanternfishes, boarfishes, barracudinas, and flatheads. Specimens vigorously defend themselves by whipping their bodies and long second dorsal spines when captured.

Size : Maximum total length 75 cm (adult females).

Interest to Fisheries : None at present.

Literature : Fourmanoir & Rivaton (1979).

Remarks : Inadequately described but apparently distinct from other species of *Squalus*.

Squalus mitsukurii Jordan & Snyder, 1903

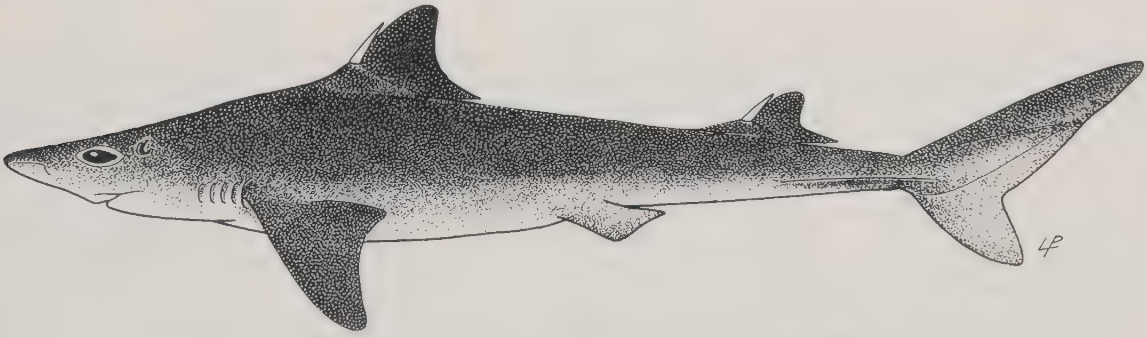
SQUAL Squal 6

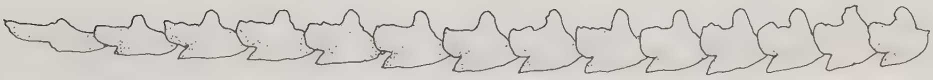
Squalus mitsukurii Jordan & Snyder, 1901, Annot.Zool.Japon., 3:129 (nomen nudum); Jordan & Snyder, in Jordan & Fowler, 1903, Proc.U.S.Nat.Mus., 26(1324):629, but not fig. 3 (? = Squalus acanthias). Holotype : Stanford University Natural History Museum, SU-12793, ca. 724 mm adult female. Type Locality : Misaki, Japan.

Synonymy : ? Squalus philippinus Smith & Radcliffe, 1912 (not S. philippinus Shaw, 1804 = Heterodontus portusjacksoni (Meyer, 1793)); ? Squalus griffini Phillipps, 1931; ? Squalus montalbani Whitley, 1931 (replacement name for S. philippinus Smith & Radcliffe, 1912); ? Squalus tasmaniensis Rivero, 1936.

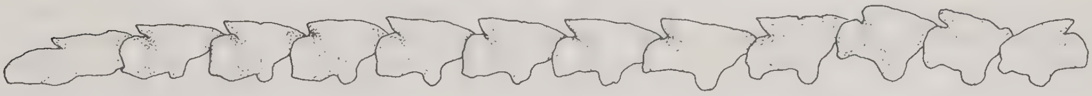
Other Scientific Names Recently in Use : Squalus fernandinus Molina, 1782 (= S. acanthias Linnaeus, 1758); Squalus blainville (Risso, 1826).

FAO Names : En - Shortspine spurdog; Fr - Aiguillat épinette; Sp - Galludo espinilla.

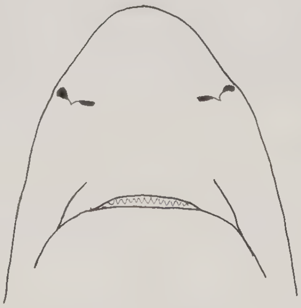




upper and lower teeth of right side



Field Marks : Two dorsal fins with ungrooved large spines, first dorsal spine origin in front of pectoral rear tips, first dorsal spine much shorter than fin base, first dorsal low and less than 2/3 as high as long, moderately long rounded-parabolic snout with distance from tip to inner nostril greater than distance from nostril to upper labial furrow, tricuspidate lateral denticles, no white spots, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.



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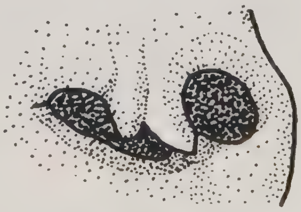
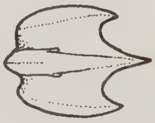
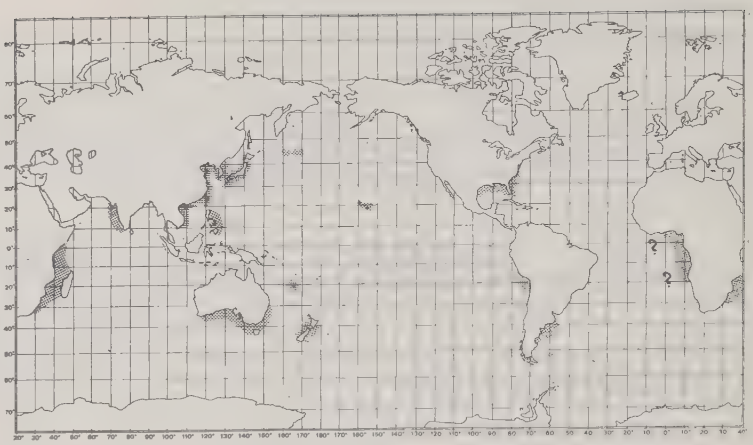


left nostril



dermal denticle

Diagnostic Features : Body fairly stout. Snout parabolic-rounded, broad, and moderately long, diagonal distance from snout tip to excurrent aperture of nostril greater than that from excurrent aperture to upper labial furrow, preoral snout about 1.1 to 1.4 times mouth width, preorbital snout less than twice eye length; eyes nearer the snout tip than the first gill slits; nostrils closer to snout tip than mouth; anterior nasal flap with small posterior secondary lobe, considerably narrower at base than distance from its base to inner corner of nostril. First dorsal spine moderately long, much less than fin base and with tip falling well below apex of fin; second spine long, about as high as fin, and less than 6% of total length; first dorsal fin more anteriorly situated, with fin origin about over pectoral insertions and spine origin over pectoral inner margins and in front of their rear tips; first dorsal moderately high, height less than 2/3 its length from origin to rear tip; second dorsal markedly smaller than first, with height usually less than 5% of total length. Precaudal pits strong; pectoral fins broad and semifalcate, posterior margins slightly concave, rear tips narrowly rounded; pelvic midbases closer to second dorsal base than first; caudal fin narrow-lobed and long, with long ventral lobe and strongly notched postventral margin. Precaudal pits strong. Lateral trunk denticles tricuspidate and with strongly scalloped posterior borders in adults. Colour: no white spots present on sides of body, fins with white edges but without conspicuous dark markings. Size moderate, up to about 1 m.



Geographical Distribution : Western North Pacific: Japan, the Koreas, China, probably Taiwan Island and Viet Nam, also seamounts in the North Pacific. Western South Pacific: Possibly New Zealand. Central Pacific: Hawaiian Islands (Chen, Taniuchi & Nose, 1979). There are dogfishes very similar to this species and possibly identical off Tasmania and Australia, the Philippines, South Africa, and the eastern and western Atlantic, that are apparently not conspecific with S. blainvillei. Records of S. blainvillei or S. fernandinus from the western Indian Ocean (Mozambique, Madagascar, Tanzania, and India), New Caledonia, and the eastern Pacific off northern Chile may also involve S. mitsukurii.

Habitat and Biology : A common dogfish of warm-temperate and tropical seas, found near or on the bottom on the continental and insular shelves and upper slopes at depths of 180 to 300 m in the western North Pacific; the Hawaiian Islands at 165 to 518 m; and New Zealand at 4 to 55 m. Very similar and perhaps conspecific dogfishes occur at depth of 432 m off the Philippines, at 50 to 740 m off South Africa, at 183 to 549 m off southern Australia and Tasmania, at 190 m off northern Chile, and 330 to 394 in the Gulf of Mexico.

Ovoviviparous. Off the east coast of South Africa this species or a close relative has 4 to 9 young per litter, with most births in the autumn, a possible gestation period of up to two years, and sexual segregation of females in the southern part of its range. Off South Africa this shark or a cognate feeds mostly on bony fishes (57%), cephalopods (31%) and crustaceans (10%).

Size : Maximum total length 110 cm, females mature at 72 cm and males betwee 65 and 89 cm; size at birth about 22 to 26 cm.

Interest to Fisheries : Apparently common in the western North Pacific, and taken in fisheries there, but details unknown.

Literature : Whitley (1940); Fowler (1941); Bigelow & Schroeder (1957); Garrick (1960b); Bass, d'Aubrey & Kistnasamy (1976); Chen, Taniuchi & Nose (1979).

Remarks : The arrangement of this species follows the recent revision of western North Pacific blainvillei-like dogfishes by Chen, Taniuchi & Nose (1979). I have examined the holotype of S. philippinus Smith & Radcliffe, 1912 and found that it agrees with S. mitsukurii in most details (specimen is USNM 70257, 32.5 cm immature male, from off Sombrero Island, Philippine Islands in 432 m depth). I include it as a possible synonym of S. mitsukurii (along with the replacement name S. montalbani), but note that Chen, Taniuchi & Nose (1979) regarded the species as being distinct from S. mitsukurii without mentioning details. They apparently did not examine the holotype of S. philippinus.

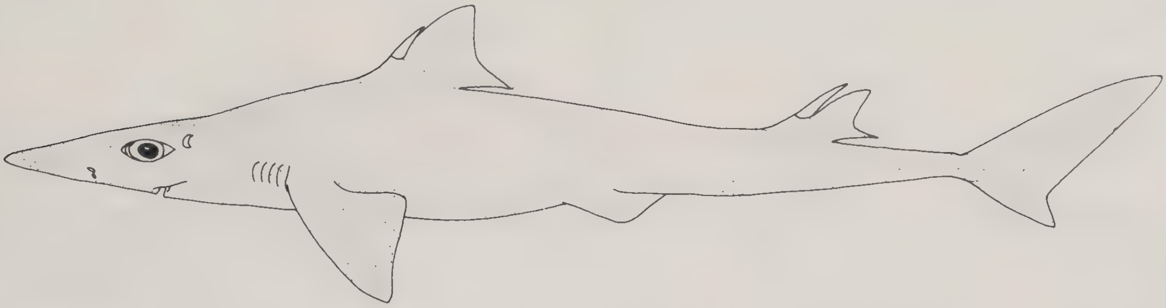
Squalus rancureli Fourmanoir & Rivaton, 1979

SQUAL Squal 9

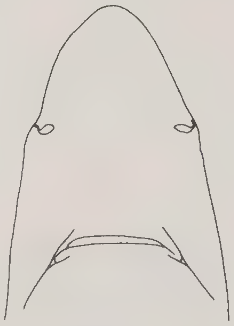
Squalus rancureli Fourmanoir & Rivaton, 1979, Cah.Indo-Pacifique, (4):437, figs 25-26. Holotype : Muséum National d'Histoire Naturelle, Paris, MNHN 1978-693, 740 mm adult female. Type Locality : Vate, New Hebrides.

Synonymy : None.

FAO Names : En - Cyrano spurdog; Fr - Aiguillat cyrano; Sp - Galludo cirano.



Field Marks : Two dorsal fins with ungrooved large spines, first dorsal spine origin in front of pectoral rear tips, snout rounded-parabolic and extremely long, preoral snout about twice mouth width, no conspicuous black tips on fins, no white spots on sides, oblique-cusped cutting teeth in both jaws, no subterminal notch on caudal fin, ventral caudal lobe very short, no anal fin, and upper precaudal pit and lateral keels on caudal peduncle.



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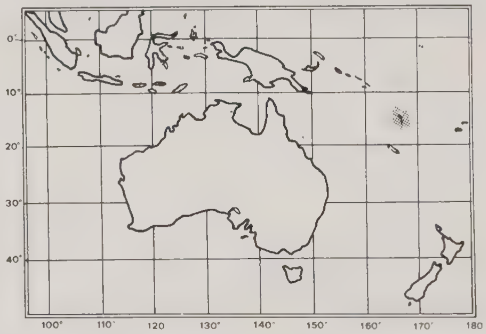
Diagnostic Features : Body fairly slender. Snout narrowly parabolic, narrow, and very long, diagonal distance from snout tip to excurrent aperture of nostril greater than that from excurrent aperture to upper labial furrow, preoral snout about 2.0 times mouth width, preorbital snout over twice eye length; eyes much closer to first gill slits than snout tip; nostrils closer to mouth than snout tip; anterior nasal flap with posterior secondary lobe apparently absent. First dorsal spine moderate-sized, less than half of fin base and with tip falling well below apex of fin; second spine long, slightly higher than fin, and about 5% of total length; first dorsal fin anteriorly situated, with fin and spine origins over pectoral inner margins; first dorsal fairly high, height slightly over 3/4 of its length from origin to rear tip; second dorsal markedly smaller than first, and with height more than 5% of total length; pectoral fins probably semifalcate and with narrowly rounded rear tips; pelvic midbases somewhat closer to first dorsal base than second; caudal fin narrow-lobed and long, but with a short ventral lobe and strongly notched postventral margin. Precaudal pits strong. Lateral trunk denticles tricuspidate and with apparently weakly scalloped posterior borders in adults. Colour: no white spots on body, fins not conspicuously black. Size moderate, up to 77 cm.



Geographical Distribution : Only known from the vicinity of Vate, New Hebrides.

Habitat and Biology : A little-known but distinctive, long-nosed deepwater dogfish of the insular slopes of New Hebrides, at depths of 320 and 400 m. Probably ovoviviparous, number of young 3.

Size : Maximum total length 77 cm (adult females), females maturing at about 65 cm and reaching at least 77 cm; size at birth near 24 cm.

Interest to Fisheries : None at present.

Remarks : Inadequately described but undoubtedly distinct from other species of Squalus.

3.3 FAMILY OXYNOTIDAE Gill, 1872

OXYN

Family Oxynotidae Gill, 1872, Smiths.Misc.Coll., (247):24.

Synonymy : Subfamily Centrinae Swainson, 1838 (family Squalidae).

FAO Names : En - Rough sharks; Fr - Centrines; Sp - Cerdos marinos, Tiburones ojinotos.

Field Marks : Unmistakable compressed, rough-skinned small sharks with high, sail-like spined dorsal fins and no anal fin.

Diagnostic Features : Trunk stout and compressed, high, with strong abdominal ridges. Head slightly depressed. Fifth (last) gill slits not abruptly expanded in width. Spiracles large and close behind eyes. Nostrils enlarged and close to each other, separated by a space much less than their width. Mouth transverse, with very long labial furrows that virtually encircle the mouth; lips expanded and papillose. Teeth strongly differentiated in upper and lower jaws, with a strong cusp and no cusplets; upper teeth small and narrow, not bladelike, lowers large, compressed and bladelike, and with erect, broad, triangular cusps. Two very large, high, sail-like, spined dorsal fins, both larger than the pelvic fins, with spines buried in the fin up to their tips; first dorsal with its base extending anteriorly to over the pectoral fin bases and gill openings. Caudal fin with a subterminal notch.

Habitat, Distribution and Biology : Oxynotids are temperate to tropical, poorly known, deepwater bottom sharks of distinctive and bizarre appearance, that live on the upper continental and insular slopes and outer shelves at depths of 40 to 720 m. They currently have a disjunct distribution, off Venezuela in the western Atlantic, British Isles to South Africa in the eastern Atlantic, and Australia and New Zealand in the western Pacific. All the four species are small and harmless sharks, mostly smaller than 1 m but exceptionally to 1.5 m in one species.

These sharks, judging from their appearance are probably sluggish and rely on their expanded body cavities and large oily livers (16 to 23% of total weight in one species) to attain neutral buoyancy, so they can hover and slowly swim above the substrate without needing forward motion for lift. The prey of these sharks is little known, and includes polychaetes. Their mouths are very small and ringed with papillose lips, and their teeth are small though strong, suggesting a diet of small bottom invertebrates and fishes. The very large nostrils and nasal organs and labial papillae may be especially important in locating prey. Development is ovoviviparous, without a placenta; litters 7 or 8.

Interest to Fisheries : Very limited, as these sharks are relatively uncommon catches in bottom and pelagic trawl fisheries. They are mostly processed for fishmeal and oil, but also prepared smoked and dried salted for human consumption.

Remarks : This family, with its single genus Oxynotus, is very close to the Family Squalidae, Subfamily Somniosidae (genera Centroscymnus, Scymnodon, Scymnodalatias, and Somniosus) of Compagno (1973c), and is often synonymized with the Squalidae. Pending further works on squaloid interrelationships I prefer to retain it as a family following Bigelow & Schroeder (1957) and Bass, d'Aubrey & Kistnasamy (1976).

Oxynotus Rafinesque, 1810

OXYN Oxyn

Genus : Oxynotus Rafinesque, 1810, Indice Ittiolog.Siciliana, Messina, 45-60.

Type Species : Oxynotus centrina Rafinesque, 1810, by monotypy, a junior synonym of Squalus centrina Linnaeus, 1758.

Synonymy : Subgenus Centrina Cuvier, 1817 (Genus Squalus Linnaeus, 1758); Genus Centrinus Swainson, 1838 (? emendation).

Key to Species :

1a. First dorsal fin spine inclined backward. Colour blackish or dark brown .... **O. paradoxus**

1b. First dorsal fin spine inclined forward. Colour either light grey-brown or variegated, with dark and light bands

    2a. Spiracle large and vertically elongated. Supraorbital ridges greatly expanded posteriorly, forming a rounded knob just in front of spiracle on each side covered with enlarged denticles .... **O. centrina**

    2b. Spiracle smaller and circular. Supraorbital ridges not greatly expanded and not forming a rounded knob in front of spiracle.

3a. Apices of dorsal fins broadly triangular, posterior margins straight or weakly concave. Colour uniform grey-brown, without prominent markings .... O. bruniensis

3b. Apices of dorsal fins narrowly triangular, posterior margins strongly concave. Colour pattern of dark bands on a light background .... O. caribbaeus

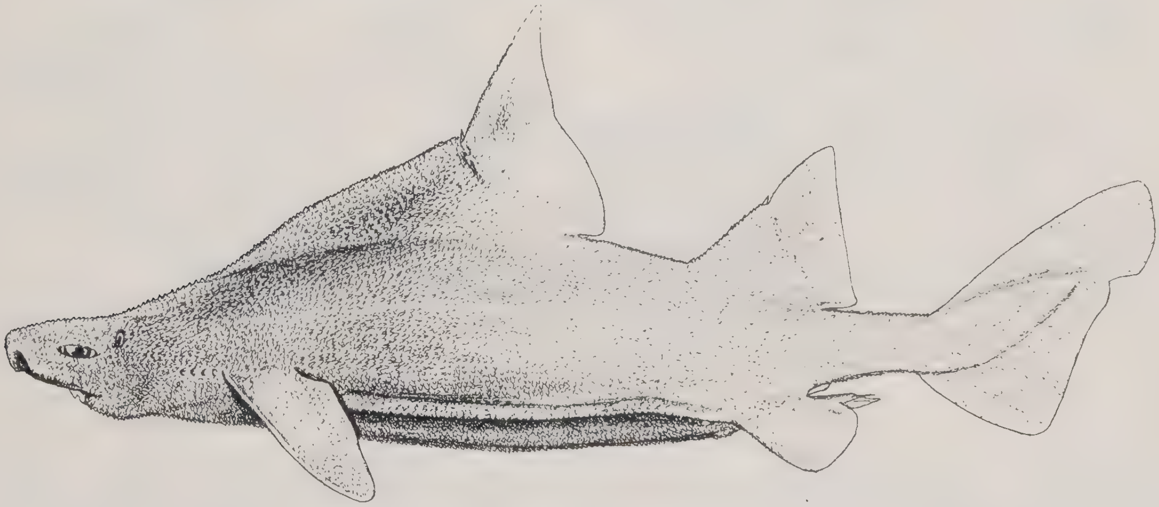
Oxynotus bruniensis (Ogilby, 1893)

OXYN Oxyn 3

Centrina bruniensis Ogilby, 1893, Rec.Australian Mus., 2(5):62. Holotype: In Tasmanian Museum. Type Locality: Bruny Island, Tasmania.

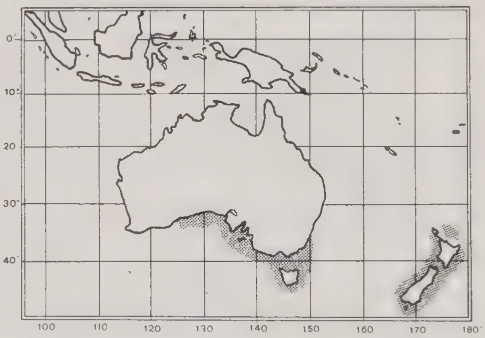
Synonymy : None.

FAO Names : En - Prickly dogfish; Fr - Centrine aiguille; Sp - Cerdo marino agujeta.



Field Marks : Short, blunt snout, high, sail-like dorsal fins with spines and broad apices, no anal fin, first dorsal spine inclined backward, high, thick, triangular body with large, rough denticles, circular spiracles, lanceolate upper teeth, lower bladelike teeth in less than 12 rows, uniform grey-brown coloration.

Diagnostic Features : Spiracle small and circular. Supraorbital ridges not greatly expanded and not forming a knob in front of spiracles. Apices of dorsal fins broadly triangular, posterior margin straight or weakly concave; first dorsal spine inclined backward. Colour uniform grey-brown, without prominent markings.



Geographical Distribution : Confined to temperate waters of the western South Pacific, off southern Australia (South Australia, Victoria, Tasmania, and New South Wales) and New Zealand.

Habitat and Biology : A little-known but fairly common deep-water bottom shark of the outer continental and insular shelves and uppermost slopes, at depths from 46 to 500 m. Ovoviviparous, a litter of 7 embryos reported for one female.

Size : Maximum total length about 72 cm, adults males 60 cm, adults females 72 cm. Size at birth greater than 10 cm.

Interest to Fisheries : None at present, taken incidentally in bottom trawlers but probably not used.

Literature : Norman (1932); Whitley (1940); Bigelow & Schroeder (1957); Garrick (1960a); Stead (1963); Cadenat & Blache (1981); Ayling & Cox (1982).

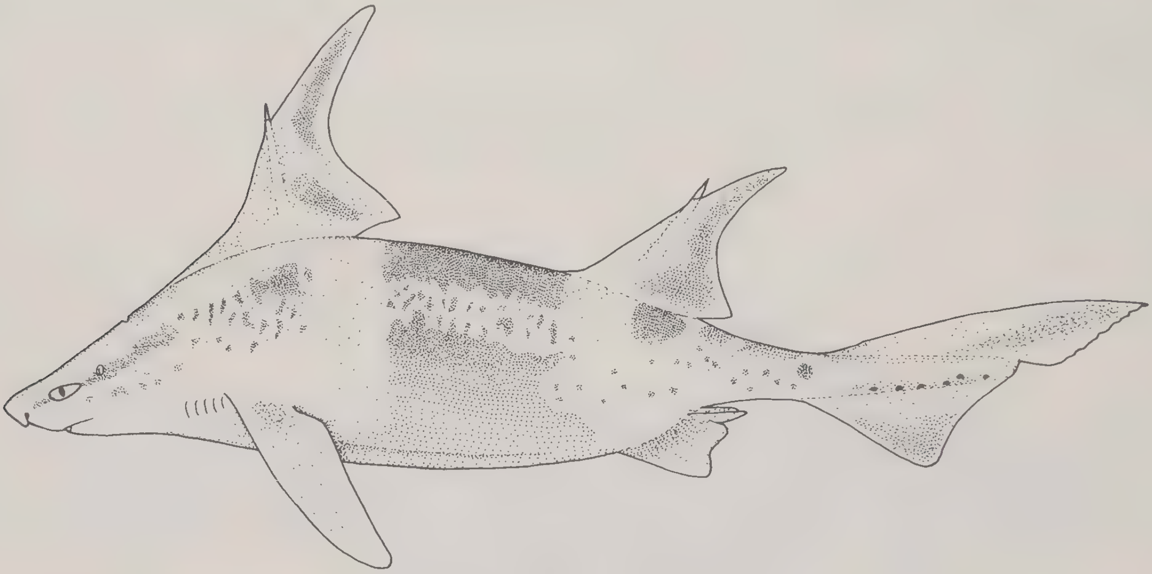
Oxynotus caribbaeus Cervigon, 1961

OXYN Oxyn 1

Oxynotus caribbaeus Cervigon, 1961, Noved.Cient.Contrib.Ocas.Mus.Hist.Nat.La Salle(Ser.Zool.), (27):10 p., figs 1-4. Holotype: Museo del Laboratorio de Biologia Pesquera del Ministerio de Agricultura y Cria, Caiguire, Venezuela, 494 mm male, probably adult. Type Locality : 60 miles north of la Blanquilla Island, Venezuela, at 457 m depth.

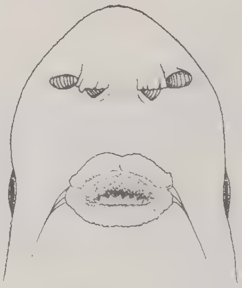
Synonymy : None.

FAO Names : En - Caribbean roughshark; Fr - Centrine antillaise; Sp - Tiburón ojinoto.



Field Marks : Short, blunt snout, high, sail-like dorsal fins with spines, no anal fin, first dorsal spine inclined forward, high, thick, triangular body with large, coarse denticles, small, circular spiracles, lanceolate upper teeth, lower bladelike teeth in less than 12 rows, colour pattern of dark bands on a light background.

Diagnostic Features : Spiracle small and circular. Supraorbital ridges not greatly expanded and not forming a knob in front of spiracles. Apices of dorsal fins narrowly triangular, posterior margins strongly concave; first dorsal spine inclined forward. Colour grey or brownish, with dark blotches and small spots on head, body, tail, and fins, separated by prominent light areas over pectoral and pelvic fins.



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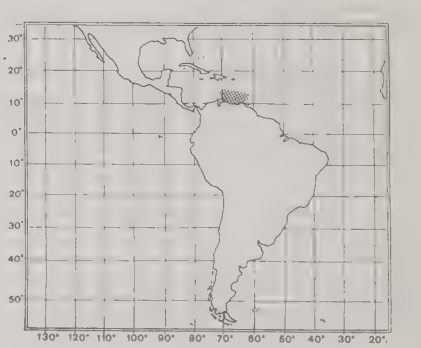
Geographical Distribution : Western North Atlantic: Venezuela.



Habitat and Biology : A little-known bottom shark of the upper continental slope off Venezuela and possibly elsewhere in the Caribbean, at depths of 402 to 457 m (bottom temperatures 9.4 to 11.1^{0}C).

Size : Maximum total length 49 cm (adult male), immatures (male and female) 20 to 21 cm.

Interest to Fisheries : None at present.

Literature : Cervigon (1961); Carpenter (1966); Compagno & Vergara (1978); Cadenat & Blache (1981).

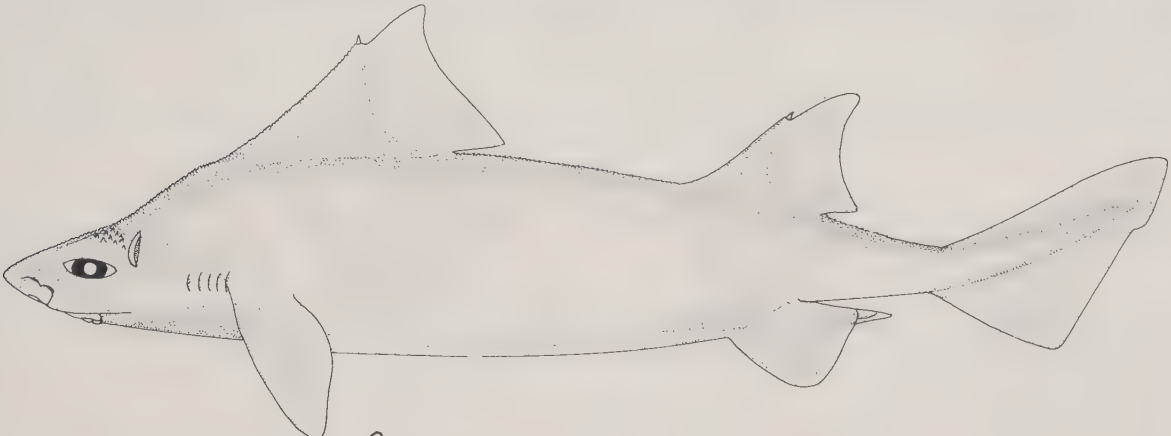
Oxynotus centrina (Linnaeus, 1758)

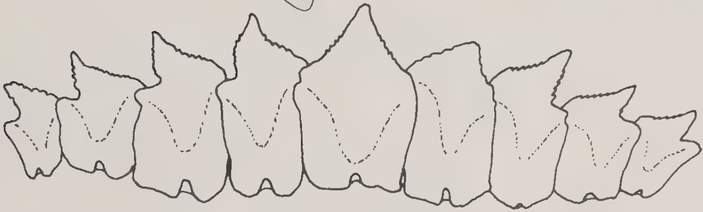
OXYN Oxyn 2

Squalus centrina Linnaeus, 1758, *Syst.Nat.*, ed. 10, 1:233. Holotype : Unknown. Type Locality: "Mare Mediterraneo".

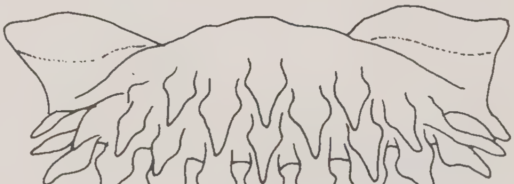
Synonymy : *Centrina salviani* Risso, 1826; *Centrina oxynotus* Swainson, 1839; *Centrina vulpecula* Moreau, 1881.

FAO Names : En - Angular roughshark; Fr - Centrine commune; Sp - Cerdo marino.



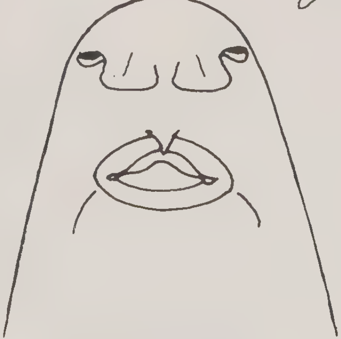


lower teeth (front view)



upper jaw and teeth

Field Marks : Short, blunt snout, high, sail-like dorsal fins with spines, no anal fin, first dorsal spine inclined forward, high, thick, triangular body with large, rough denticles, massive knobs on supraorbital ridges, vertically elongated spiracles, lanceolate upper teeth, lower bladelike teeth in less than 12 rows, colour pattern of darker marks on a light background.



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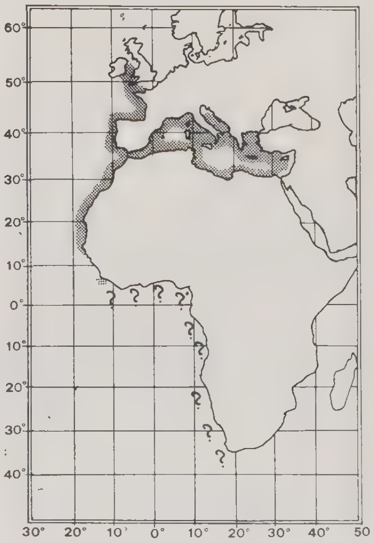
Diagnostic Features : Spiracle large and vertically elongated, crescent or oval in shape. Supraorbital ridges enlarged over eyes, with a knoblike posterior expansion studded with large denticles and ending in front of spiracles. Apices of dorsal fins broadly triangular, posterior margins shallowly concave; first dorsal spine inclined forward. Colour grey or grey-brown above and below, with darker blotches on head and sides; a light horizontal line separates dark areas on head and another crosses cheeks below eyes.



Geographical Distribution : Eastern Atlantic: Bay of Biscay and Mediterranean Sea to Senegal, north apparently as a stray to Cornwall, England; also possibly from Liberia to Nigeria, Gabon to Namibia, and South Africa.

Habitat and Biology : An uncommon, little-known bottom shark of the continental shelf and upper slope at depths of 60 to 660 m. Ovoviviparous, litters probably of 7 or 8 young. Eats polychaetes.

Size : Maximum total length about 150 cm, but most individuals smaller; maturing at about 50 cm.

Interest to Fisheries : Caught in bottom and pelagic trawls and utilized for fishmeal, oil, and smoked and dried salted for human consumption. Apparently not abundant and mainly a minor bycatch of large offshore trawler fleets.

Literature : Lozano y Rey (1928); Norman (1932); Poll (1951); Bigelow & Schroeder (1957); Cadenat (1957); Maurin & Bonnet (1970); Bass, d'Aubrey & Kistnasamy (1976); Cadenat & Blache (1981); Compagno (1981).

Remarks : Bass, d'Aubrey & Kistnasamy (1976) noted that the Oxynotus recorded as O. centrina from Angola, Namibia, and South Africa may not be that species but an undescribed one, differing from O. centrina in having a much shorter interdorsal space. If this is correct, the records of O. centrina from tropical West Africa need to be reexamined, but until the problem is resolved the southern and southwestern African Oxynotus is retained in O. centrina.

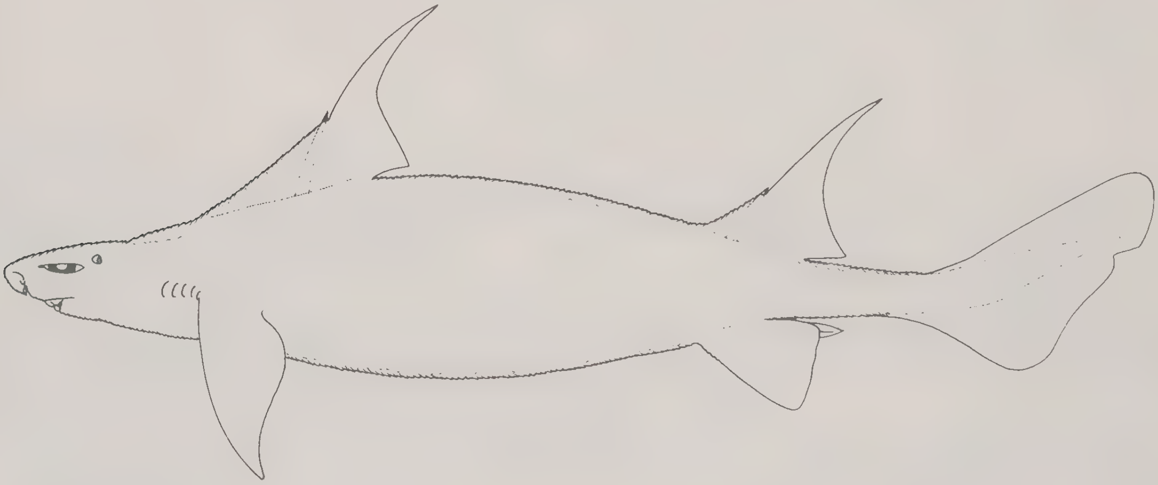
Oxynotus paradoxus Frade, 1929

OXYN Oxyn 4

Oxynotus paradoxus Frade, 1929, Bull.Soc.Portugaise Sci.Nat., 10(22):22, fig. 1. Holotype: In Museu Bocage, Lisbon, apparently lost in a fire that destroyed the museum. Type Locality: Off Morocco.

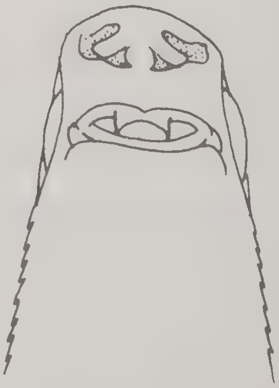
Synonymy : None

FAO Names : En - Sailfin roughshark; Fr - Humantin; Sp - Cerdo marino velero.



Field Marks : Short, blunt snout, high, sail-like dorsal fins with spines, no anal fin, first dorsal spine inclined backward, high, thick, triangular body with large, rough denticles, lanceolate upper teeth, lower bladelike teeth in less than 12 rows, blackish coloration.

Diagnostic Features : Spiracle small and circular. Supraorbital ridges not greatly expanded and not forming a knob in front of spiracles. Apices of dorsal fins narrowly triangular, posterior margins strongly concave; first dorsal spine inclined backward. Colour blackish or dark brown, without prominent markings.



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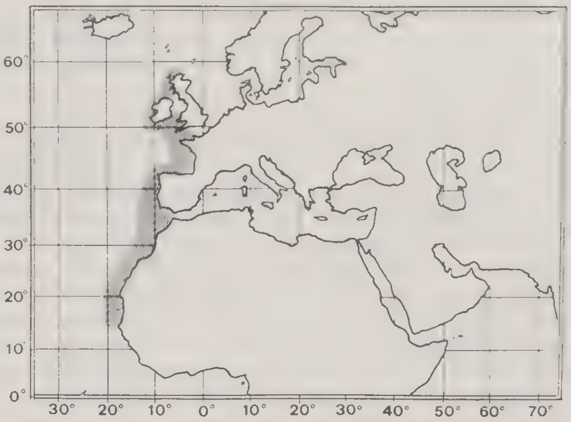
Geographical Distribution : Eastern North Atlantic: Atlantic slope from Scotland to Senegal.

Habitat and Biology : An uncommon deepwater bottom shark found on the Atlantic continental slope at depths from 265 to 720 m. Moderately abundant off British Isles. Ovoviviparous.

Size : Maximum total length about 118 cm; size at birth about 25 cm.

Interest to Fisheries : Caught in bottom trawls and used for fishmeal. Uncommon as a bycatch of offshore trawling fleets.

Literature : Norman (1932); Maurin & Bonnet (1970); Wheeler (1978); Cadenat & Blache (1981).



4. ORDER PRISTIOPHORIFORMES - SAW SHARKS

Order Pristiophoriformes Compagno, 1973c, J.Linn.Soc.(Zool.), 53 suppl. 1.

Synonymy : Order Asterospondyli: Gill, 1893 (in part). Order Euselachii, Suborder Galei: Jordan, 1923 (in part). Order Euselachii, Suborder Squaloidei: Blot, 1969 (in part). Suborder Galei: Gill, 1872 (in part). Suborder Plagiostomi Tectospondyli: Hasse, 1879 (in part). Order Pristiophorida: Fowler, 1969. Order Pristiophorae: Smith, 1949. Order Pristiophori: Whitley, 1940. Order Pristiophoriformes: Berg & Svedovidov, 1955; Patterson, 1967; Lindberg, 1971; Rass & Lindberg, 1971; Applegate, 1974; Chu & Wen, 1979. Suborder Pristiophorina: Matsubara, 1955. Suborder Pristiophoroidea: Bigelow & Schroeder, 1948. Suborder Pristiophoroidei: Nelson, 1976. Order Squalea, Suborder Squalida: White, 1936, 1937 (in part). Suborder Squali: Gill, 1862 (in part). Order Squaliformes, Suborder Squaloidei: Berg, 1940 (in part); Arambourg & Bertin, 1958. Suborder Squaliformes: Goodrich, 1909 (in part); Bertin, 1939 (in part), Budker & Whitehead, 1971 (in part). Order and Suborder Squaloidea: Schultz & Stern, 1948 (in part). Suborder Squaloidea: Romer, 1945, 1966 (in part); Norman, 1966 (in part). "Division" Squaloidei: Regan, 1906 (in part). "Group" Squaloidei: Garman, 1913 (in part). Suborder Squaloidei: Engelhardt, 1913 (in part). Order Squatinae: Fowler, 1941 (in part).

Diagnostic Features : Trunk somewhat depressed but not greatly flattened and raylike. Head somewhat depressed but not expanded laterally; 5 or 6 pairs of gill slits present on sides of head, with the posteriormost in front of pectoral fin origins; spiracles present and very large, just behind and above level of eyes; nostrils without barbels, nasoral grooves or circumnarial grooves, separate from mouth, anterior nasal flaps short and not reaching mouth; eyes on dorsal surface of head, without nictitating lower eyelids; snout very long and greatly depressed, forming a sawlike blade with lateral denticles and a pair of long rostral barbels on its ventral surface well in front of the nostrils; mouth small, arched but short, behind eyes; labial furrows greatly reduced, at mouth corners only; teeth weakly differentiated along the jaws, without enlarged anterior or posterior teeth and without a gap or small intermediate teeth between anterior and lateral teeth in the upper jaw. Two spineless dorsal fins present, the first with its origin over the interspace between the pectoral and pelvic bases; pectoral fins moderately large, not expanded and raylike, without triangular anterior lobes that cover the gill slits; pelvic fins small, with vent continuous with their inner margins; anal fin absent; caudal fin with a moderately long dorsal lobe but with ventral lobe absent; vertebral axis elevated into the dorsal caudal lobe. Intestinal valve of spiral type.

4.1 FAMILY PRISTIOPHORIDAE Bleeker, 1859

PRISTIOP

Family Pristiophoroidei Bleeker, 1859, Act.Soc.Sci.Ind.Neerl., 4(3):xii.

Synonymy : Family Pliotremidae Jordan, 1923.

FAO Names : En - Saw sharks; Fr - Requins scie; Sp - Tiburones sierra.

Field Marks : Long, flat snout with lateral sawteeth and ventral barbels, two spineless dorsal fins and no anal fin.

Habitat, Distribution and Biology : Sawsharks are little-known temperate and tropical benthic and epibenthic inhabitants of the continental and insular shelves and upper slopes from close inshore to at least 915 m depth. Temperate sawsharks are found in shallow bays and estuaries down to offshore sand and gravel banks at modest depths, but one tropical species is a deepwater slope inhabitant at 640 m and below. The sawshark family is presently confined to the western North Atlantic in the vicinity of the Bahamas, the southeastern Atlantic and western Indian Ocean from the western Cape, South Africa, to southern Mozambique, apparently the Arabian Sea (where an undescribed species may occur), and the western Pacific off Japan, the Koreas, China, the Philippines and Australia. Fossil finds indicate that sawsharks were formerly more widespread, in the eastern Pacific and eastern North Atlantic.

Sawsharks are small and very slender, with a maximum total length of about 137 cm.

Several sawsharks are abundant where they occur, and are found in large schools or feeding aggregations. Despite their abundance, their habits are poorly known. At least one species shows segregation by depth within populations, with adults in deeper water than young.

Sawsharks are ovoviviparous, and may have litters of 7 to 17 large young that are 28 to 35 cm long at birth. Apparently sawshark fetuses gain nutrients primarily from their large yolk sacks, which are resorbed just before birth. Apparently the large lateral rostral teeth erupt before birth in sawsharks, but to prevent injury to the mother these large teeth lie flat against the rostrum in fetuses until after birth. Smaller teeth erupt between the large ones after birth.

Food habits of sawsharks are poorly known, but their prey includes small fishes, crustaceans and squids. The long rostral barbels may have taste sensors, that these sharks trail along the bottom like those of sturgeons (Acipenseridae) and catfishes (Siluriformes) to locate prey. The long, rather delicate rostrum has lateral line and ampullal sensors for vibration and electrolocation, like a paddlefish (Polyodontidae) snout. The lateral rostral teeth, flat snout and head, enlarged occipital condyles, and specialized cervical vertebrae of sawsharks are evident modifications that allow these sharks to use their rostra as offensive weapons to kill their prey and possibly stir up bottom sediments to rouse prey organisms, but unlike the batoid sawfishes (Pristidae) this behaviour has not been observed, probably because sawsharks apparently have not been kept in captivity with any success (unlike sawfishes) and have not been studied underwater where they occur. The very short jaws and long oral and gill cavities of sawsharks suggest that they are capable of suddenly sucking prey into their mouths.

Because of their small size and small, cuspidate teeth sawsharks are considered to be inoffensive to people (unlike large sawfishes which have occasionally injured and even killed bathers and may be a hazard to fishermen when caught in nets and on line gear). The rostral teeth of sawsharks are sharp as needles though apparently nontoxic, so that these fishes should be handled with care to prevent puncture wounds on one's limbs.

Interest to Fisheries : Considerable fisheries for sawsharks have occurred off southern Australia. They are taken and used in the western North Pacific to some extent, but details are sketchy. Sawsharks are commonly taken in the southwestern Indian Ocean off South Africa and southern Mozambique, but may be little utilized there. Sawsharks are caught in bottom trawls, and used fresh for human consumption.

Remarks : Arrangement of this family follows Springer & Bullis (1959).

Key to Genera and Species :

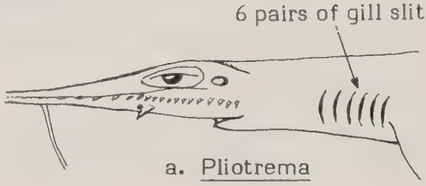
1a. Six pairs of gill openings (Fig. 1a). Larger rostral teeth serrated (Fig. 2) .... **Pliotrema warreni**

1b. Five pairs of gill openings (Fig. 1b). Larger rostral teeth smooth (Pristiophorus)

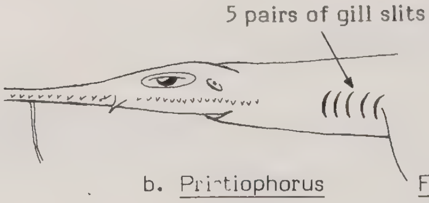
2a. Lateral trunk denticles largely tricuspidate. Preoral snout longer, about 31 to 32% of total length (Fig. 3) .... **Pristiophorus schroederi**

2b. Lateral trunk denticles largely unicuspidate. Preoral snout less than 30% of total length

3a. Rostrum relatively short and broad, distance from rostral tip to barbels much greater than distance from barbels to mouth. Dorsal and pectoral fins partially naked in large specimens (Fig. 4) .... **Pristiophorus nudipinnis**

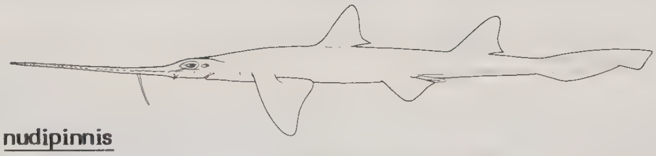


a. Pliotrema



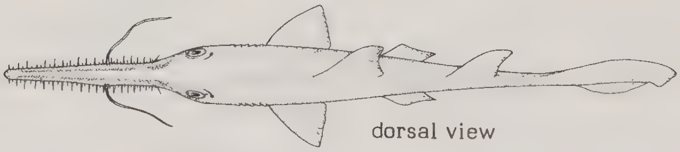
b. Pristiophorus

Fig. 1



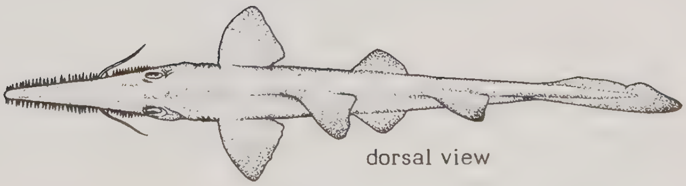
Pliotrema warreni

Fig. 2



Pristiophorus schroederi

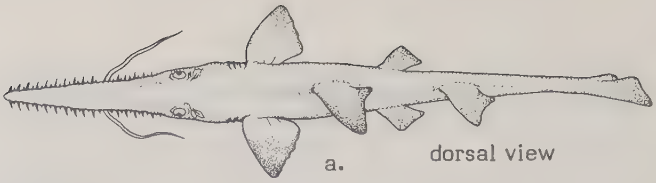
Fig. 3



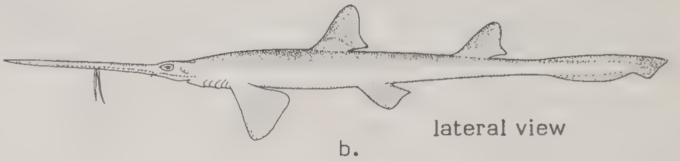
Pristiophorus nudipinnis

Fig. 4

3b. Rostrum long and narrower, distance from rostral tip to barbels about equal or slightly greater than distance from barbels to mouth. Dorsal and pectoral fins covered with denticles in large specimens (Figs 5a,b) .... **Pristiophorus cirratus**
Pristiophorus japonicus



Pristiophorus cirratus



Pristiophorus japonicus Fig. 5

Pliotrema Regan, 1906 PRISTIOP Plio

Genus : Pliotrema Regan, 1906a, Ann.Natal Mus., 1(1):1.

Type Species : Pliotrema warreni Regan, 1906, by monotypy.

Synonymy : None.

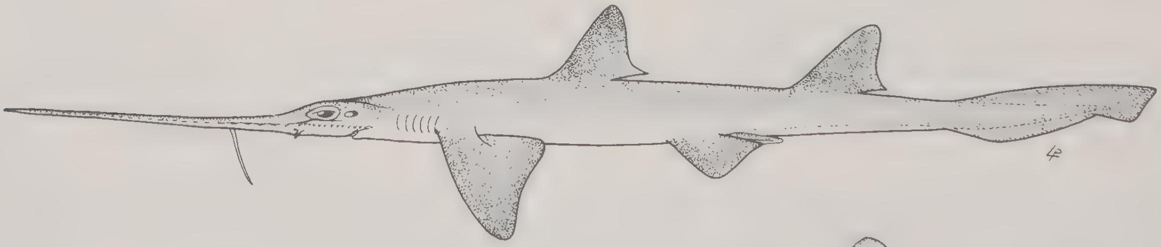
Diagnostic Features : Six pairs of gill slits. Large rostral sawteeth with posterior serrations. Teeth with prominent transverse ridges on basal ledges.

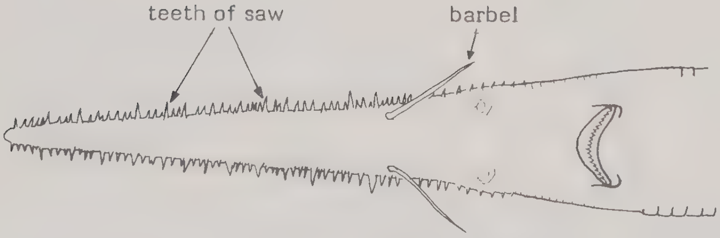
Pliotrema warreni Regan, 1906 PRISTIOP Plio 1

Pliotrema warreni Regan, 1906a, Ann.Natal Mus., 1(1):1, pl. 1. Syntypes: British Museum (Natural History), BMNH 1905.6.8.9 is one of two specimens, each 750 mm total length. Type Locality: Two localities in South Africa given, Natal, 73 m depth, and False Bay, Cape of Good Hope.

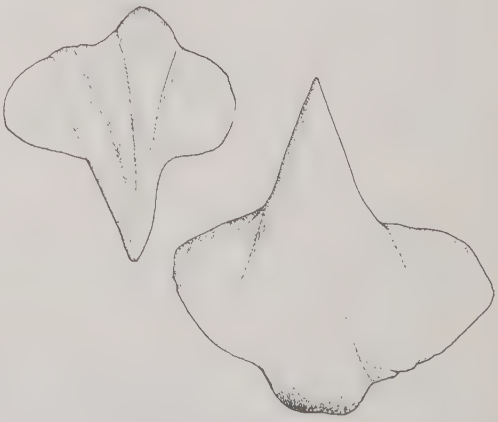
Synonymy : None.

FAO Names : En - Sixgill sawshark; Fr - Requin scie flutian; Sp - Tiburón sierra del Cabo.





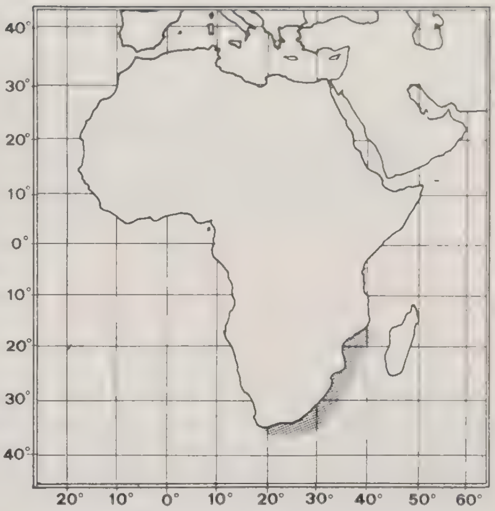
underside of head



upper and lower tooth

Field Marks : Six pairs of gill slits, sawlike snout with barbels.

Diagnostic Features : See genus.



Geographical Distribution : Temperate and subtropical waters of the western Indian Ocean: Distribution centred on the southeastern Cape coast of South Africa, but ranging from False Bay to central Natal and southern Mozambique.

Habitat and Biology : A common benthic and epibenthic shark of the continental shelf and upper slope at depths of 60 to at least 430 m. It is most abundant in southeastern Cape waters at 60 to 120 m, but occurs in deeper water off Natal (110 m and below), where adults are partially segregated from young by occurring in greater depths. Ovoviviparous, with 5 to 7 young in a litter in two females but with others having 7 to 17 developing eggs. Eats small fish (including Champsodon), crustaceans and squids.

Size : Maximum total length at least 136 cm; males maturing at about 83 cm and reaching at least 112 cm; females maturing at about 110 cm and reaching at least 136 cm; size at birth about 35 cm.

Interest to Fisheries : Commonly taken by bottom trawlers off South Africa and southern Mozambique, but usage not known.

Literature : Fowler (1941); Smith (1949); Bass, d'Aubrey & Kistnasamy (1975c).

Pristiophorus Müller & Henle, 1837

PRISTIOP Prist

Genus : Pristiophorus Müller & Henle, 1837, Ber.K.Preuss.Akad.Wiss.Berl., 2:116.

Type Species : Pristis cirratus Latham, 1794, by monotypy.

Synonymy : None.

Field Marks : Rostral saw and barbels, five pairs of gill slits, two spineless dorsal fins and no anal fin.

Diagnostic Features : Five pairs of gill slits. Large rostral sawteeth without posterior serrations. Teeth without prominent transverse ridges on basal ledges.

Remarks : The present systematic arrangement of Pristiophorus follows Springer & Bullis (1960) with modifications. Dr Bruce Welton (pers.comm.) notes that he examined specimens of a Pristiophorus collected in deep water in the Arabian Sea while in Karachi. The identification of these specimens is uncertain, and could represent a new species of sawshark.

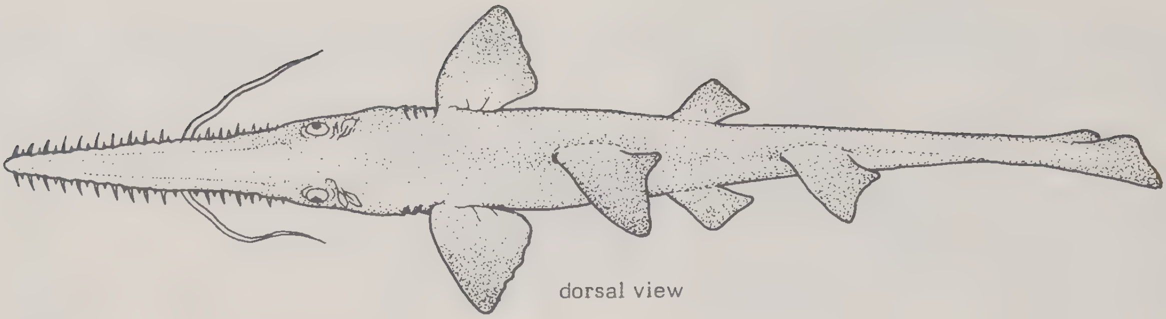
Pristiophorus cirratus (Latham, 1794)

PRISTIOP Prist 2

Pristis cirratus Latham, 1794, Trans.Linn.Soc.London, 2(25):281, pl. 26, fig. 5, pl. 27. Holotype possibly in British Museum (Natural History)?, male about 1020 mm long, from Port Jackson, Australia.

Synonymy : Squalus anisodon Lacepède, 1802; Squalus tentaculatus Shaw, 1804.

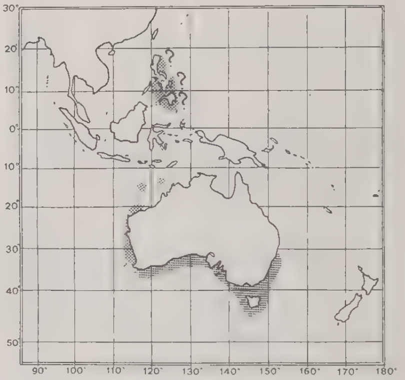
FAO Names : En - Longnose sawshark; Fr - Requin scie à long nez; Sp - Tiburón sierra trompudo.



dorsal view

Field Marks : Five pairs of lateral gill slits, long, narrow sawshark snout 27 to 28% of total length, largely lanceolate denticles, two spineless dorsal fins, and no anal fin.

Diagnostic Features : Rostrum long, narrow, and narrowly tapering, length of preoral snout 27 to 29% of total length. Bases of rostral barbels about 1.2 to 1.3 times closer to rostral tip than mouth; distance from rostral barbels to nostrils slightly less or equal to distance from nostrils to first to fourth gill slits. About 9 or 10 large rostral teeth on each side of rostrum in front of rostral barbels, 9 behind them. Distance from mouth to nostrils 1.3 to 1.4 times internarial space. Tooth rows 39 to 49 in upper jaw. Dorsal and pectoral fins covered with denticles in large specimens. Lateral trunk denticles largely unicuspidate. First dorsal origin behind free rear tips of pectorals by eye length or slightly less.



Geographical Distribution : Western Pacific: Australia (South and Western Australia, New South Wales, Tasmania, Victoria), possibly the Philippines.

Habitat and Biology : A common temperate-subtropical sawshark of the continental shelf and upper slope of Australia, found near or on the bottom from close inshore to at least 311 m depth. Occurs in bays and estuaries, but more abundant offshore at about 37 to 146 m on sandy or gravel-sand bottoms. Apparently occurs in schools or aggregates, possibly for feeding. Ovoviviparous, said to "breed in the winter month" (Whitley, 1940). Eats small fishes, including coronet fishes (*Fistularia*), and crustaceans.

Size : Maximum total length about 137 cm, size at birth about 31 to 34 cm.

Interest to Fisheries : This abundant small shark has formed the basis for a considerable bottom trawl fishery off southern Australia, the catches from which are utilized fresh for human consumption. Apparently the meat of this shark is excellent eating.

Local Names : AUSTRALIA: Common sawshark, Little sawshark.

Literature : Günther (1870); Garman (1913); Whitley (1940); Fowler (1941); Springer & Bullis (1960); Stead (1963).

Remarks : See the account of *P. japonicus* for notes on the difficulties in separating that species from *P. cirratus*. I have examined two specimens of sawsharks from the Philippines which may be this species or *P. japonicus* but may differ from *P. cirratus* in having the rostral barbels slightly closer to the mouth than the snout tip (possibly variable in *P. cirratus*). Whether the Philippine specimens can be assigned to either species hinges on whether or not these species can be separated.

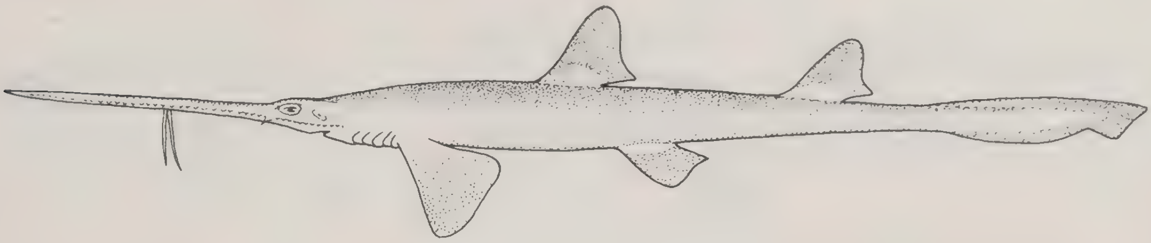
Pristiophorus japonicus Günther, 1870

PRISTIOP Prist 3

Pristiophorus japonicus Günther, 1870, *Cat.Fish.British Mus.*, 8:433. Syntype : British Museum (Natural History), BMNH 1862.11.1.37. Type Locality : Japan.

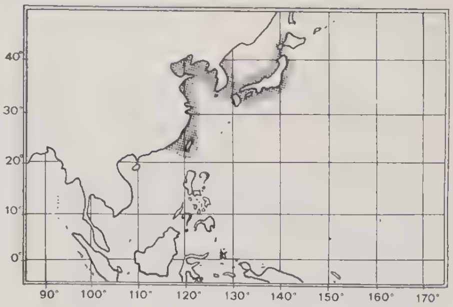
Synonymy : None.

FAO Names : En - Japanese sawshark; Fr - Requin-scie moustache; Sp - Tiburón sierra japonés.



Field Marks : Five pairs of lateral gill slits, long, narrow sawshark snout 26 to 29% of total length, largely lanceolate denticles, two spineless dorsal fins, and no anal fin.

Diagnostic Features : Rostrum long, narrow, and narrowly tapering, length of preoral snout 26 to 29% of total length. Bases of rostral barbels about 1.1 to 1.2 times closer to mouth than rostral tip; distance from rostral barbels to nostrils about equal to distance from nostrils to first to fourth gill slits. About 15 to 26 large rostral teeth on each side of rostrum in front of rostral barbels, 9 to 17+ behind them. Distance from mouth to nostrils 1.1 to 1.2 times internarial space. Tooth rows 34 to 58 in upper jaw. Dorsal and pectoral fins covered with denticles in large specimens. Lateral trunk denticles largely unicuspidate. First dorsal origin behind free rear tips of pectorals by eye length or more.



Geographical Distribution : Western North Pacific: Japan, the Koreas, northern China, Taiwan Island, possibly the Philippines.

Habitat and Biology : A common sawshark of the western North Pacific continental shelves and upper slopes on or near bottom. Lives in coastal waters, on sand or mud bottoms. Ovoviviparous, number of young usually 12. Feeds on small bottom organisms; said to use barbels along bottom and poke the bottom with its snout.

Size : Maximum total length for adult females about 136 cm.

Interest to Fisheries : Probably of limited importance, though in Japan its meat is considered of high quality and used to prepare "kameboko" for human consumption.

Literature : Günther (1870); Garman (1913); Fowler (1941), Springer & Bullis (1960); Masuda, Araga & Yoshino (1975).

Remarks : This species is very close to P. cirratus and was referred to that species by earlier writers. Günther (1870) distinguished the two species by differences in tooth counts, and by comparison of the distance between rostral barbels and nostrils (equal to distance between nostrils and fourth gill slits in cirratus, nearly equal to that between nostrils and first gill slits in japonicus). However, the proportional character fails in that some japonicus examined have the barbel-nostril interspace equal to that from the nostrils to fourth gill slits, and tooth counts overlap in the material examined and in literature counts. Use of tooth counts is also confounded by increases in tooth counts with growth in this and probably other sawsharks (a small Japanese sawshark 49.5 cm total length had 34 rows of upper teeth, a large one about 136 cm 57 rows, while intermediate-sized specimens had intermediate counts). Because of the limited material examined of P. cirratus, I am uncertain if rostral tooth counts and the position of the barbels on the snout (closer to the snout tip than mouth in cirratus, slightly closer to the mouth than the snout tip in japonicus) are valid differences between these species. The separation of the two species P. cirratus and P. japonicus is unsatisfactory at present, but I hesitate to merge them until more adequate samples than I have been able to examined can be compared.

Sawsharks from the Philippines may be this species or P. cirratus (see that species for a discussion).

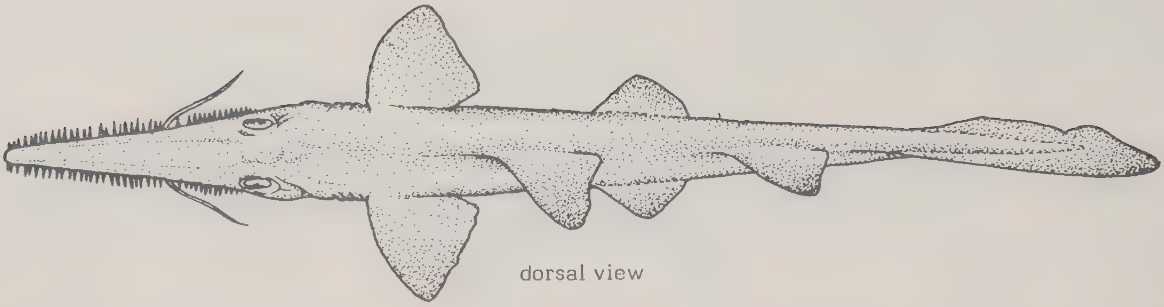
Pristiophorus nudipinnis Günther, 1870

PRISTIOP Prist 4

Pristiophorus nudipinnis Günther, 1870, Cat.Fishes British Mus., 8:432. Syntype : In British Museum (Natural History), BMNH 1869.2.24.2, 1040 mm male, probably adult. Type Locality : Tasmania or South Australia.

Synonymy : ? Pristiophorus owenii Günther, 1870.

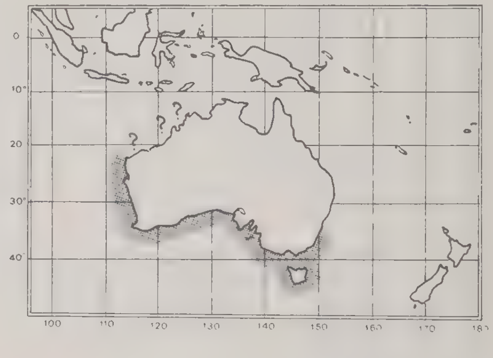
FAO Names : En - Shortnose sawshark; Fr - Requin scie à nez court; Sp - Tiburón sierra ñato.



Field Marks : Five pairs of lateral gill slits; rather broad, short sawshark snout 23 or 24% of total length, rostral barbels considerably closer to mouth than rostrum tip, largely lanceolate denticles, two spineless dorsal fins, and no anal fin.

Diagnostic Features : Rostrum rather short, broad, and abruptly tapering, length of preoral snout 23 or 24% of total length. Bases of rostral barbels about 1.4 to 1.5 times closer to mouth than rostral tip; distance from rostral barbels to nostrils about equal to distance from nostrils to rear corners of mouth. About 13 large rostral teeth on each side of rostrum in front of rostral barbels, 6 behind them. Distance from mouth to nostrils 0.9 times internarial space. Tooth rows 33 to 35 in upper jaw. Dorsal and pectoral fins largely naked in large specimens. Lateral trunk denticles largely unicuspidate. First dorsal origin about opposite free rear tips of pectorals.

Geographical Distribution : Western South Pacific: Australia (South and Western Australia, Victoria, Tasmania, New South Wales).



Habitat and Biology : A common temperate-subtropical sawshark of the Australian continental shelf, found on or near the bottom at 37 to 165 m depth. Ovoviviparous.

Size : Maximum total length at least 122 cm; size at birth about 28 cm.

Interest to Fisheries : Caught with bottom trawls off southern Australia, and used fresh for human consumption.

Local Names : AUSTRALIA: Southern sawshark.

Literature : Günther (1870); Garman (1913); Whitley (1940); Fowler (1941); Springer & Bullis (1960); Stead (1963).

Remarks : Pristiophorus owenii was described by Günther (1870) from a 32.3 cm newborn specimen without locality (BMNH 1859.9.11.1) in the British Museum (Natural History). This was distinguished from other sawsharks by its equally long rostral teeth (other species have teeth of different sizes). Garman (1913) noted that this species differed from P. cirratus only in its regular-sized teeth, but thought this might be a juvenile characteristic. Fowler (1941) synonymized P. owenii with P. cirratus, but Spriger & Bullis (1960) resurrected the species. They noted that P. owenii was similar to P. nudipinnis in having a short snout, but distinguished owenii by its rostral teeth. They noted that a juvenile specimen of nudipinnis illustrated by McCulloch (1911) had rostral teeth of varied sizes. However, McCulloch's sawshark and another juvenile nudipinnis of similar size and rostral teeth examined by me in the Australian Museum (Sydney, AMS I 21303-001) are considerably larger (44.5 to 44.6 cm long) than a newborn specimen of apparent nudipinnis (SU 25492, 27.5 cm total length) from Australia which has owenii-like even rostral teeth. Another Australian newborn sawshark (SU 20805, 33.4 cm total length) is apparently P. cirratus, yet has owenii-like sawteeth. All this and Whitley's (1940, fig. 173, no. 1) illustration of a 30 cm late fetal cirratus with even teeth leads me to believe that such teeth are characteristic of late fetal and newborn sawsharks (as suspected by Garman, 1913). I include P. owenii in synonymy of P. nudipinnis because of its short snout, but consider this tentative because of the absence of locality data for the holotype of owenii.

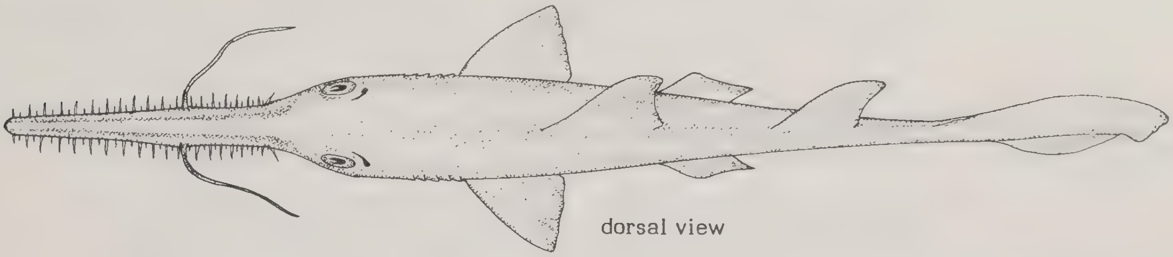
Pristiophorus schroederi Springer & Bullis, 1960

PRISTIOP Prist 1

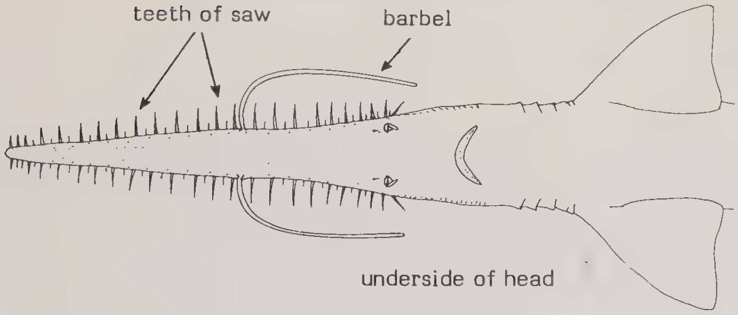
Pristiophorus schroederi Springer & Bullis, 1960, Bull.Mar.Sci.Gulf Caribb., 10(2):241, figs 1-3, 5. Holotype: US National Museum of Natural History, USNM 185946, 383 mm immature female. Type Locality: About 15 miles east of Dog Rocks, Cay Sol Bank, 24°05'N, 79°46'W, at 640 m depth.

Synonymy : None.

FAO Names : En - Bahamas sawshark; Fr - Requin scie d'Amérique; Sp - Tiburón sierra americano.



dorsal view



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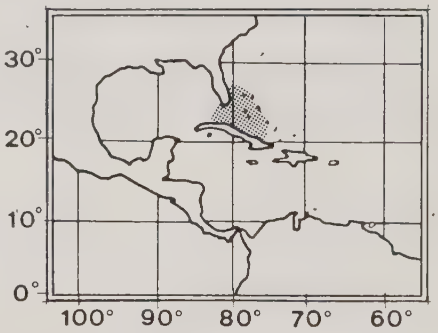
Field Marks : Five pairs of lateral gill slits, extremely long, narrow sawshark snout 31 to 32% of total length, largely tricuspidate lateral denticles, two spineless dorsal fins, and no anal fin.

Diagnostic Features : Rostrum very long, narrow, and narrowly tapering, length of preoral snout 31 to 32% of total length. Bases of rostral barbels about 1.1 times closer to mouth than rostral tip; distance from rostral barbels to nostrils about equal to distance from nostrils to second to fourth gill slits. About 13 to 14 large rostral teeth on each side of rostrum in front of rostral barbels, 9 to 10 behind them. Distance from mouth to nostrils 1.2 times internarial space. Tooth rows 33 to 36 in upper jaw. Dorsal and pectoral fins covered with denticles in large specimens. Lateral trunk denticles largely tricuspidate. First dorsal origin about opposite free rear tips of pectorals.

Geographical Distribution : Western North Atlantic: Bahamas region, between Cuba, Florida and the Bahamas.



Habitat and Biology : A little-known, deep-water, tropical sawshark of the continental and insular slopes of the Bahamas region, occurring on or near the bottom at depths from 640 to 915 m.

Size : Maximum total length at least 80 cm.

Interest to Fisheries : None at present.

Literature : Springer & Bullis (1960).

5. ORDER SQUATINIFORMES - ANGELSHARKS

5.1 FAMILY SQUATINIDAE Bonaparte, 1838

SQUAT

Subfamily Squatinini Bonaparte, 1838 (Family Squalidae), Nuov.Ann.Sci.Nat.Bologna, ser.1, 2:206.

Synonymy : Family Rhinoidae Gill, 1862, and its emendation to Family Rhinidae.

FAO Names : En - Angelsharks, Sand devils; Fr - Anges de mer; Sp - Angelotes, Peces angel.

Field Marks : Batoid-like form; but with free anterior pectoral lobes lateral to gills and lower lobe of caudal fin longer than upper

Habitat, Distribution and Biology : Angelsharks are unique, bizarrely-shaped sharks with a broad distribution in cool temperate to tropical waters, ranging in depth from close inshore in the intertidal down to the upper continental slopes at over 1300 m. They are often found buried in mud and sand on the bottom during the daytime, but at least some species are night-active, and swim off the bottom after dusk. They have a mostly ambitemperate range, with a few species being found in equatorial waters, but several occur in warm temperate waters and a few range into cold northern boreal waters. Angelsharks are found primarily in continental waters, in the eastern North and South Pacific, western North and South Atlantic, eastern Atlantic, extreme southwestern Indian Ocean, temperate western North and South Pacific, but do not occur in most of the Indian Ocean nor in the Central Pacific reaches of Oceania. Most angelsharks are of moderate size, below 1.6 m, but at least one species may reach 2 m. They feed on a variety of small bony fishes, crustaceans, cephalopods, gastropods and bivalves, and use their highly protrusable, traplike jaws to suddenly snap up prey at high speed. They are harmless to people unless disturbed or provoked, but if aroused can be aggressive and are capable of causing serious but not lethal cuts with their small but sharp teeth and strong jaws. Their relatively small size and bottom habitat makes them minimally dangerous to people, and they primarily pose a minor hazard to fisheries personnel that have to handle them in catches.

Interest to Fisheries : Several of the species are intensively fished, especially by bottom trawl, line gear and fixed bottom nets, and used for human consumption, oil, fishmeal, leather and shagreen for woodworking. The flesh of these sharks is excellent for human food, despite their bizarre and unusual appearance.

Remarks : Arrangement of this family follows Bigelow & Schroeder (1948), with some emendations and additions. The angel sharks remain a poorly known group taxonomically and bioligcally, and the treatment herein accorded them is provisional in the extreme.

Squatina Dumeril, 1806

SQUAT Squat

Genus : Squatina Dumeril, 1806, Zool.Anal., 102.

Type Species : Squatina vulgaris Risso, 1810, by subsequent designation of Risso (1810:45, see discussion below); a junior synonym of Squalús squatina Linnaeus, 1758.

Synonymy : Genus Rhina Schaeffer, 1760 (rejected by ICZN); Genus Rhina Cuvier, 1817 (not Rhina Bloch & Schneider, 1801); Genus Squalraia de la Pylaie, 1835.

Remarks : Dumeril's (1806) account of the genus Squatina mentioned no species, but it is obvious that Dumeril intended it for Squalus squatina Linnaeus, 1758. Risso (1810), the next user of the genus Squatina, attributed it to Dumeril and included in it a single species, Squatina vulgaris Risso, 1810 (a junior synonym of Squalus squatina Linnaeus, 1758). Risso's action can be interpreted as a subsequent designation of a type species for Squatina Dumeril, S. vulgaris (= S. squatina).

Key to Species :

1a. Anterior nasal barbels bifurcated or strongly fringed; posterior margin of anterior nasal flaps between nasal barbels and tip moderately to strongly fringed

2a. Upper surface of body with large brown ocelli in addition to small light spots

3a. Nasal barbels and anterior nasal flaps strongly fringed. A few large spines on snout and above eyes. Pectoral fins more rounded .... **S. tergocellata**

3b. Nasal barbels weakly fringed, anterior nasal flaps moderately fringed. Numerous small spines present on snout and above eyes. Pectoral fins more angular .... **S. tergocellatoides**

2b. Upper surface of body without large brown ocelli, but usually with white spots

4a. Large spines present on midline of back and tail from head to dorsal fins and between the fin bases. Dermal folds on sides of head with prominent triangular lobes. Fringes on anterior nasal flaps very strong and deep .... **S. aculeata**

4b. Spines on midline of back small or absent. Dermal folds on sides of head without triangular lobes. Fringes on anterior nasal flaps moderately deep

5a. Anterior nasal barbel weakly bifurcate. First dorsal fin usually well behind free rear tips of pelvic fins. Dermal denticles of back with three ridges .... **S. oculata**

5b. Anterior nasal barbel strongly fringed. First dorsal fin with origins about opposite free rear tips of pelvic fins. Dermal denticles of back without ridges .... **S. australis**

1b. Anterior nasal barbels simple; posterior margins of anterior nasal flaps between barbels and tips smooth to weakly fringed

6a. Dermal folds on sides of head with two lobes at and in front of mouth corner .... **S. nebulosa**

6b. Dermal folds on sides of head with a single lobe or none

7a. Dermal folds on sides of head with a triangular lobe .... **S. squatina**

7b. Dermal folds on sides of head without lobes

8a. Distance from eye to spiracle about twice eye diameter .... **S. argentina**

8b. Distance from eye to spiracle less than 1.5 times eye diameter

9a. Anterior nasal barbel with a broad, spatulate tip

10a. Free rear tips of pectoral fins broadly rounded, posterior margin nearly straight, inner margin strongly convex .... **S. japonica**

10b. Free rear tips of pectoral fins subangular, posterior margin concave, inner margin slightly convex .... **S. californica**

9b. Anterior nasal barbel with a narrow, tapering tip

11a. Free rear tips of pectoral fins narrowly subangular. Mid-dorsal spines enlarged, especially in young .... **S. dumeril**

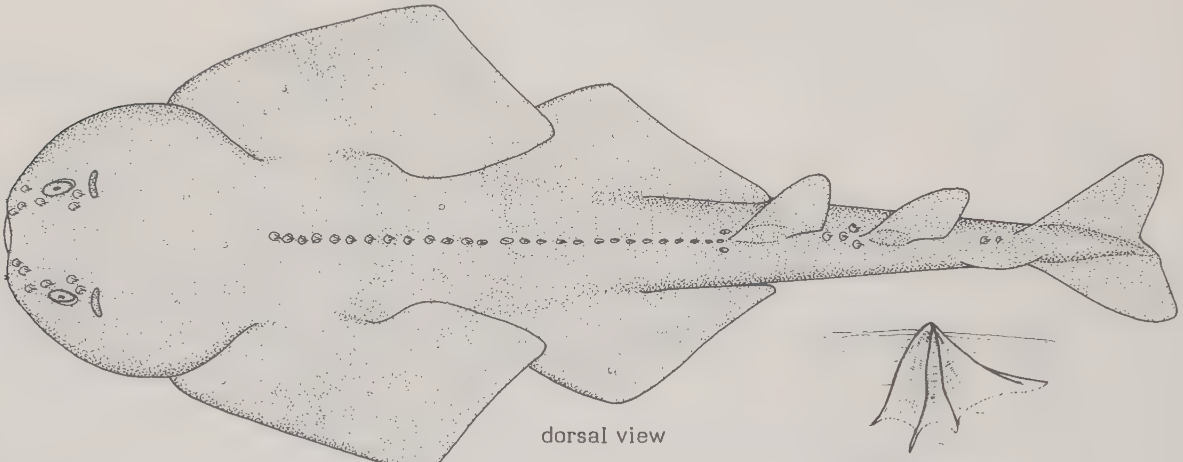
11b. Free rear tips of pectoral fins broadly angular. Mid-dorsal spines hardly enlarged .... **S. africana**

Squatina aculeata Dumeril, 1829

Squatina aculeata Dumeril, in Cuvier, 1829, Reg.Anim., ed. 2, 2:394, ftn. 2. Holotype: Muséum National d'Histoire Naturelle, Paris, MNHN 1218, 410 mm female. Type Locality: Mediterranean Sea off Marseilles, France.

Synonymy : ? Squatina fimbriata Müller & Henle, 1839.

FAO Names : En - Sawback angelshark; Fr - Ange de mer épineux; Sp - Angelote espinudo.

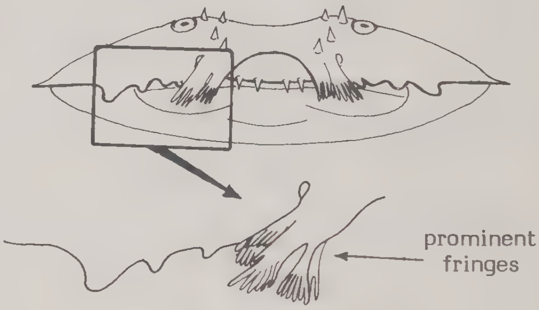


dorsal view

dermal denticle

Field Marks : An angelshark with heavy dorsal spines, heavily fringed nasal barbels and anterior nasal flaps, and no ocelli on body.

Diagnostic Features : Trunk relatively slender. Anterior nasal barbels strongly fringed; posterior margin of anterior nasal flaps between nasal barbels and tips strongly fringed; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head with 2 or 3 prominant triangular lobes. Origin of first dorsal fin usually about opposite pelvic rear tips; pectoral fins rather long and low, free rear tips narrowly subangular. Large spines present on midline of back and tail from head to dorsal fins and between the fin bases, also on snout and above eyes; lateral trunk denticles pyramidal, not hooked and with 3 ridges. Colour: no ocelli on body.



frontal view of head
(showing anterior nasal flaps)

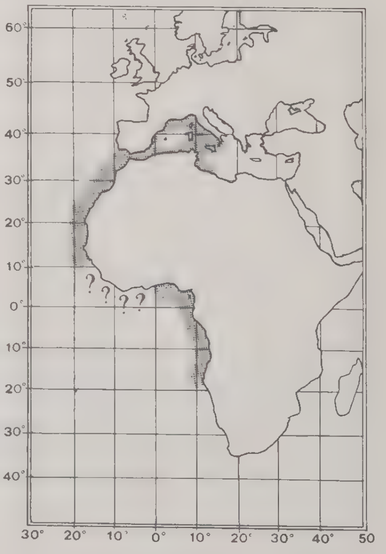
Geographical Distribution : Eastern Atlantic: Western Mediterranean, Morocco, Senegal, Guinea to Nigeria, Gabon to Angola.

Habitat and Biology : An angelshark of the continental shelf and uppermost slope of the warm-temperate and tropical eastern Atlantic, on or near the bottom at depths of 30 to 500 m. Ovoviviparous. Eats small sharks and jacks.

Size : Maximum total length about 188 cm, becoming adult at 124 cm.

Interest to Fisheries : Caught primarily in bottom trawls, but also in fixed bottom nets, on line gear, and even in pelagic trawls. Utilized dried salted and fresh for human consumption; oil and hides for leather also taken.

Literature : Cadenat (1957); Compagno (1981).



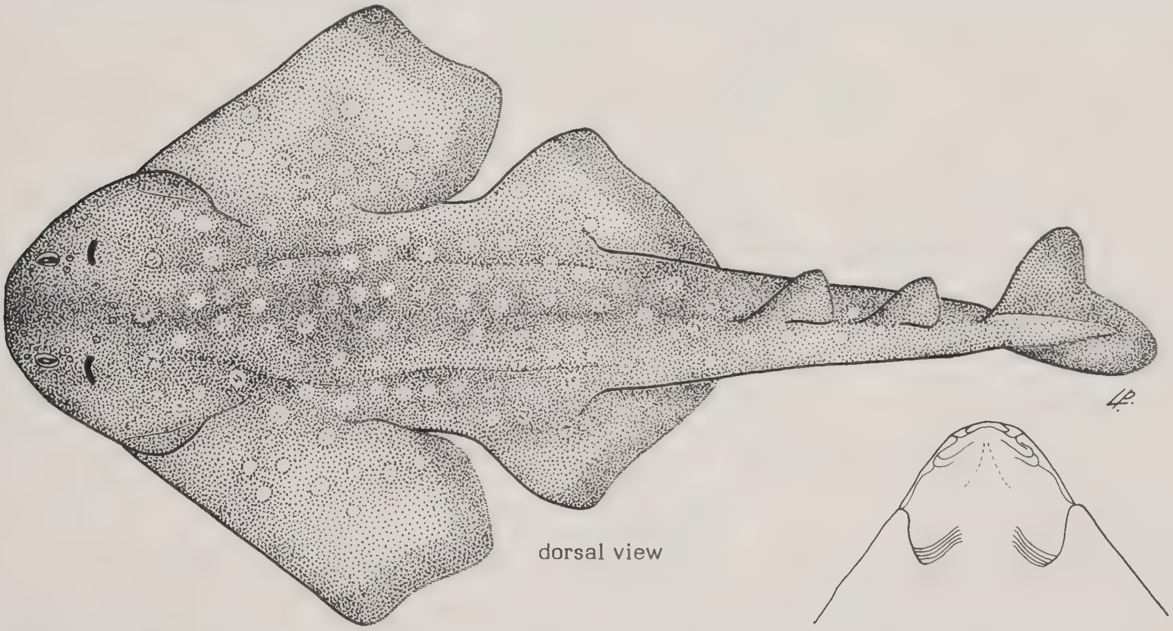
Squatina africana Regan, 1908

SQUAT Squat 5

Squatina africana Regan, 1908, Ann.Natal Gov.Mus., 1(3):248, pl. 38. Holotype: British Museum (Natural History), 800 mm male. Type Locality: Durban Bay, Natal, South Africa.

Synonymy : None.

FAO Names : En - African angelshark; Fr - Ange de mer africain; Sp - Angelote africano.

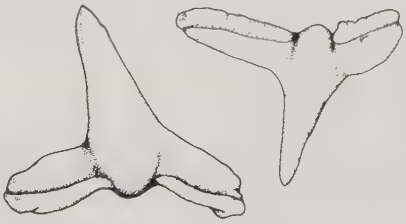


dorsal view

underside of head

Field Marks : An angelshark with simple, conical nasal barbels and virtually smooth anterior nasal flaps, dermal flaps on sides of head without angular lobes, broad, angular pectoral fins, and no ocelli on body.

Diagnostic Features : Anterior nasal barbels simple, with a narrow, tapering tip; posterior margin of anterior nasal flaps between nasal barbels and tips smooth or weakly fringed; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head without lobes; heavy spines present on snout and above eyes, but none on midline of back and tail. Origin of first dorsal fin usually in front of pelvic rear tips; pectoral fins rather broad, free rear tips broadly subangular. Colour: no ocelli on body.



lower and upper tooth

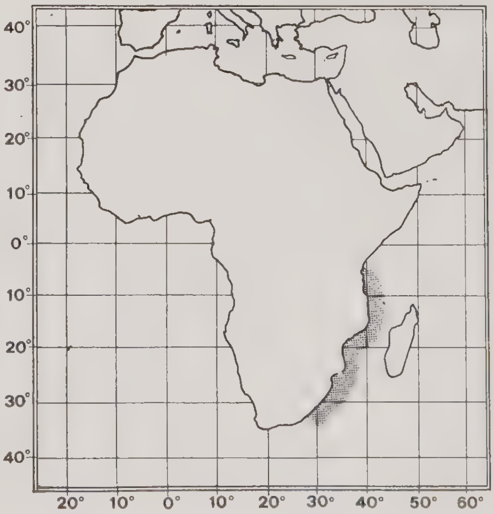
Geographical Distribution : Tropical and warm temperate waters of the southwestern Indian Ocean: Eastern Cape coast of South Africa north to Mozambique and Tanzania.

Habitat and Biology : A common benthic and epibenthic shark on the continental shelf and uppermost slope, ranging in depth from the surf line close inshore to 494 m depth, with most occurring between 60 and 300 m depth. Development ovoviviparous, number of young probably about 7 to 11 in a litter. Eats bony fishes, squids and octopuses.

Size : Maximum total length size about 108 cm, males maturing at about 75 to 78 cm and reaching over 80 cm, females maturing between 90 and 93 cm and reaching at least 108 cm; size at birth between 28 and 34 cm.

Interest to Fisheries : Limited, often taken by bottom trawlers.

Literature : Bigelow & Schroeder (1948); Smith (1949); Bass, d'Aubrey & Kistnasamy (1975c).



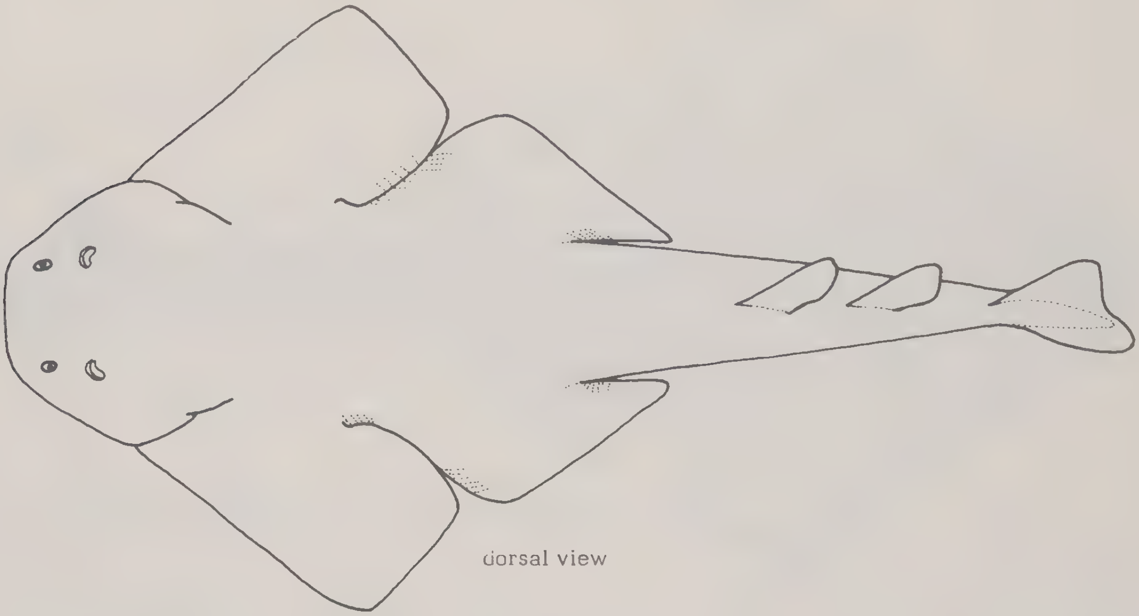
Squatina argentina (Marini, 1930)

SQUAT Squat 6

Rhina argentina Marini, 1930, Physis, 10:5, fig. 12. Holotype: In Museo Nacional, Buenos Aires, Argentina, 455 mm immature male. Type Locality: Off province of Buenos Aires, Argentina, at about 39°S and 56°W.

Synonymy : Squatina punctata Marini, 1936; Squatina guggenheim Marini, 1936.

FAO Names : En - Argentine angelshark; Fr - Ange de mer argentin; Sp - Angelote argentino.

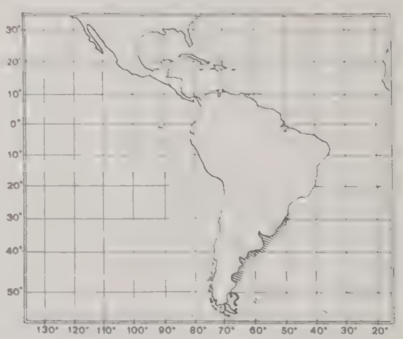


dorsal view

Field Marks : An angelshark with simple spatulate nasal barbels and weakly fringed or smooth anterior nasal flaps, dermal flaps on sides of head without angular lobes, small eyes with interspace between them and spiracles about 2.5 times eye diameter, fairly broad and posteriorly broadly rounded or angular pectoral fins, and no ocelli on body.

Diagnostic Features : Trunk moderately narrow. Anterior nasal barbels simple and with a narrowly spatulate tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed or smooth; distance from eye to spiracle about twice eye diameter; dermal folds on sides of head without triangular lobes. First dorsal origin behind pelvic rear tips; pectoral fins rather broad, with broadly rounded or subangular free rear tips. Probably spines of midline of back and head small. Colour: no ocelli on body.

Geographical Distribution : Western South Atlantic: Southern Brazil to Argentina.



Habitat and Biology : A common but poorly known temperate and subtropical angelshark of the western South Atlantic continental shelf and slope, on or near the bottom.

Size : Maximum total length 170 cm.

Interest to Fisheries : Presumably taken by bottom trawlers.

Literature : Bigelow & Schroeder (1948).

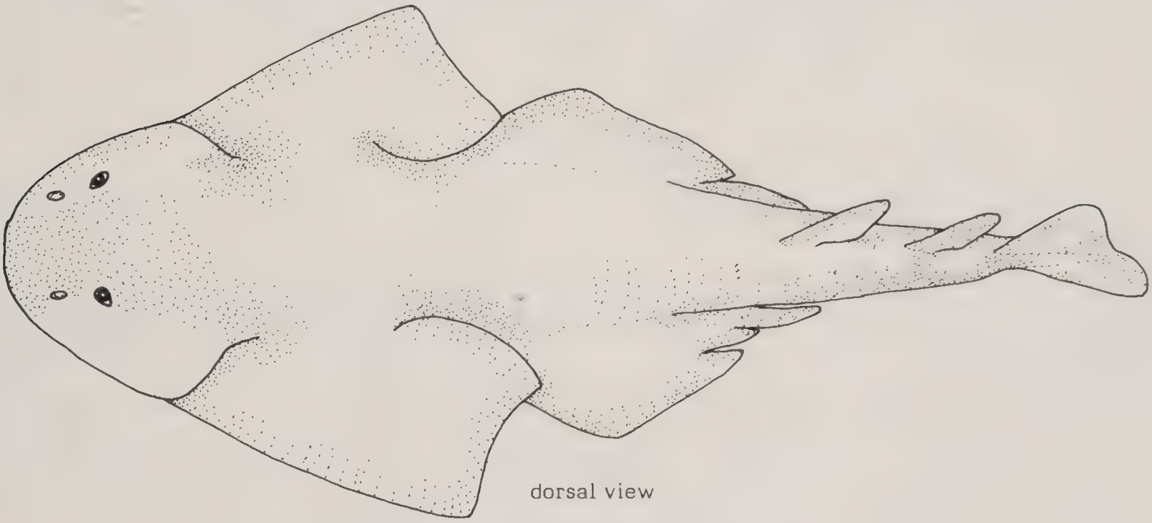
Squatina australis Regan, 1906

SQUAT Squat 7

Squatina australis Regan, 1906b, Ann.Mag.Nat.Hist., (Ser. 7), 18:438. Holotype: British Museum (Natural History), 530 mm. Type Locality: Port Jackson, Australia.

Synonymy : None.

FAO Names : En - Australian angelshark; Fr - Ange de mer australien; Sp - Angelote australiano.

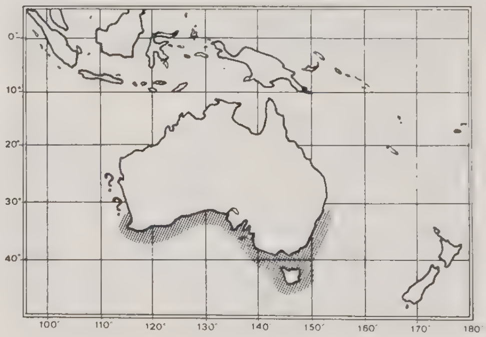


dorsal view

Field Marks : An angelshark with a broad trunk, dorsal spines weak or absent, heavily fringed nasal barbels and anterior nasal flaps, lateral dermal folds of head without triangular lobes, and no large ocelli on body.

Diagnostic Features : Trunk very broad. Anterior nasal barbels strongly fringed; posterior margin of anterior nasal flaps between nasal barbels and tips strongly fringed; distance from eye to spiracle at least 1.5 times eye diameter; dermal folds on sides of head without triangular lobes. Origin of first dorsal fin usually about opposite pelvic rear tips; pectoral fins rather short and high, free rear tips narrowly subangular. No large spines on midline of back and tail or on snout and above eyes; lateral trunk denticles without ridges. Colour: no ocelli on body, but with numerous small, symmetrical, white spots.

Geographical Distribution : Western South Pacific: Australia (South and Western Australia, New South Wales, Tasmania, Victoria).



Habitat and Biology : A common but little-known angelshark of the continental shelf and uppermost slope, on or near bottom from close inshore to 256 m depth. Ovoviviparous.

Size : Maximum total length about 152 cm.

Interest to Fisheries : Taken by bottom trawlers in Australia, utilization unknown.

Literature : Whitley (1940); Bigelow & Schroeder (1948); Stead (1963).

Squatina californica Ayres, 1859

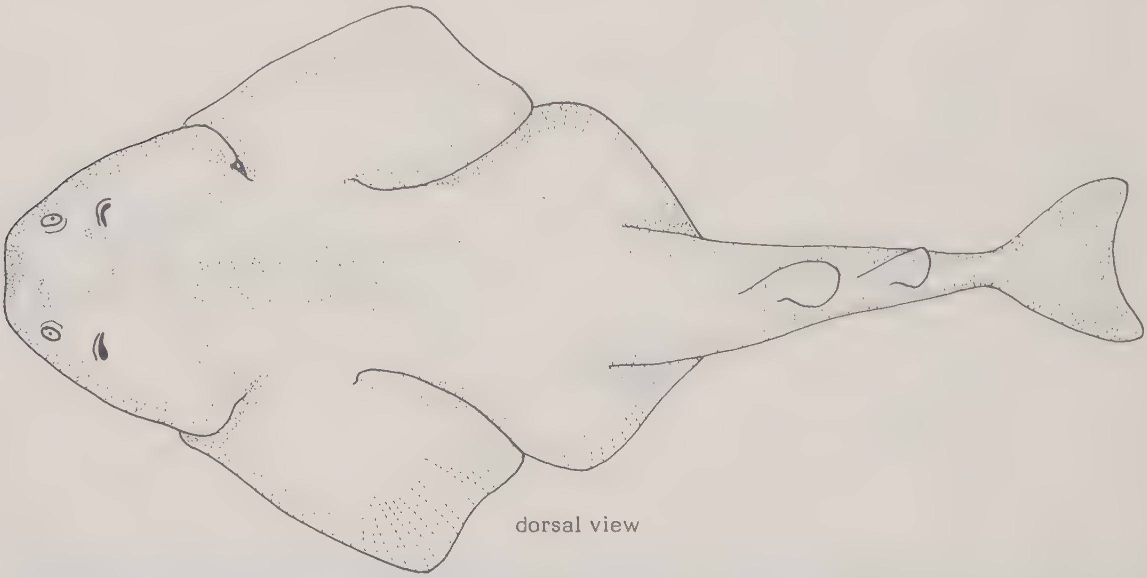
SQUAT Squat 8

Squatina californica Ayres, 1859, Proc.Calif.Acad.Sci., 2:29. Holotype: ?. Type Locality: San Francisco, California.

Synonymy : ? Rhina armata Philippi, 1887; ? Rhina philippi Garman, 1913.

Other Scientific Names Recently in Use : Squatina armata (Philippi, 1887).

FAO Names : En - Pacific angelshark; Fr - Ange de mer du Pacifique; Sp - Pez ángel del Pacífico.

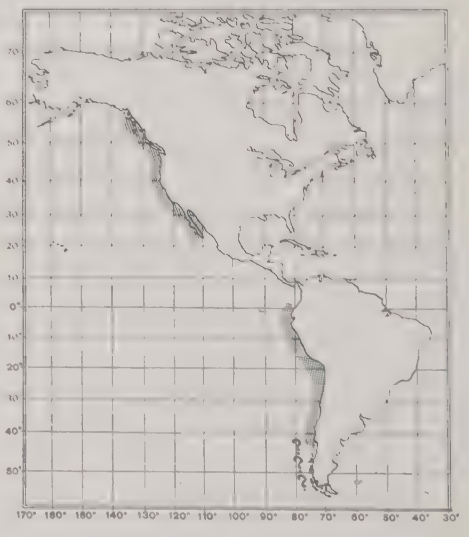


dorsal view

Field Marks : An angelshark with simple, conical nasal barbels and weakly fringed anterior nasal flaps, dermal flaps on sides of head without angular lobes, large eyes with interspace between them and spiracles less than 1.5 times eye diameter, fairly broad and angular pectoral fins, and no ocelli on body.

Diagnostic Features : Anterior nasal barbels simple and with a spatulate tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head without triangular lobes. Free rear tips of pectoral fins narrowly subangular. Small spines present on midline of back and tail from head to dorsal fins and between the fin bases; moderate-sized spines present on snout and above eyes. Colour: no ocelli on body.

Geographical Distribution : Eastern Pacific: Southeastern Alaska to Gulf of California; Ecuador to southern Chile (armata).



Habitat and Biology : A cold to warm-temperate, continental, littoral bottom shark, common to abundant in water from 3 to 46 m deep off California, but down to 183 m in the Gulf of California. It is sluggish and relatively inactive, and lies buried in sand or mud with its eyes and back exposed; its sandy, flecked, mottled colour blends well with the substrate. The Pacific angelshark is often observed around rocks, the head of submarine canyons, and sometimes near kelp forests. It is extremely abundant off the California Channel Islands. Ovoviviparous, size of litters of 10?

Feeds on bottom and epibenthic fishes, including croakers and California halibut, and squids. This is an ambush predator, like others of the family, and can quickly shoot out its jaws to grab its prey. Although not a great danger to people, this angelshark should be treated with considerable respect, because of its powerful jaws and needle-sharp if small teeth. It can whip up its head and snap very quickly when touched, provoked, harassed, or speared, and can inflict painful lacerations.

Size : Maximum total length about 152 cm, males maturing at about 75 to 80 cm and reaching at least 114 cm; mature females 86 to over 108 cm; size at birth between 21 and 26 cm.

Interest to Fisheries : This species has recently (1980-1981) become the subject of an expanding gillnet fishery off southern California, supplying high-priced fresh or fresh-frozen meat for human consumption. Skindivers and sportsfishers often hook spear, or even grab this species. In the Gulf of California, this or a closely related species is or has been taken as a bycatch of the shrimp bottom-trawl fishery, and processed along with other fishes for fishmeal. Off Peru, 205 metric tons of this species (if not distinct from S. armata) was taken in fisheries in 1978.

Literature : Garman (1913); Bigelow & Schroeder (1948); Roedel & Ripley (1950); Miller & Lea (1972); Feder, Turner & Limbaugh (1974); G. Cailliet (pers. comm.).

Remarks : Kato, Springer & Wagner (1967) synonymized the southern Angelote, Squatina armata, with this species, and this is tentatively followed here pending contrary information. S.P. Applegate (pers. comm., 1982) indicates that the Gulf of California angelshark may be a separate species from S. californica which, if correct, would reopen the question of whether the southern hemisphere Angelote is properly synonymized here.

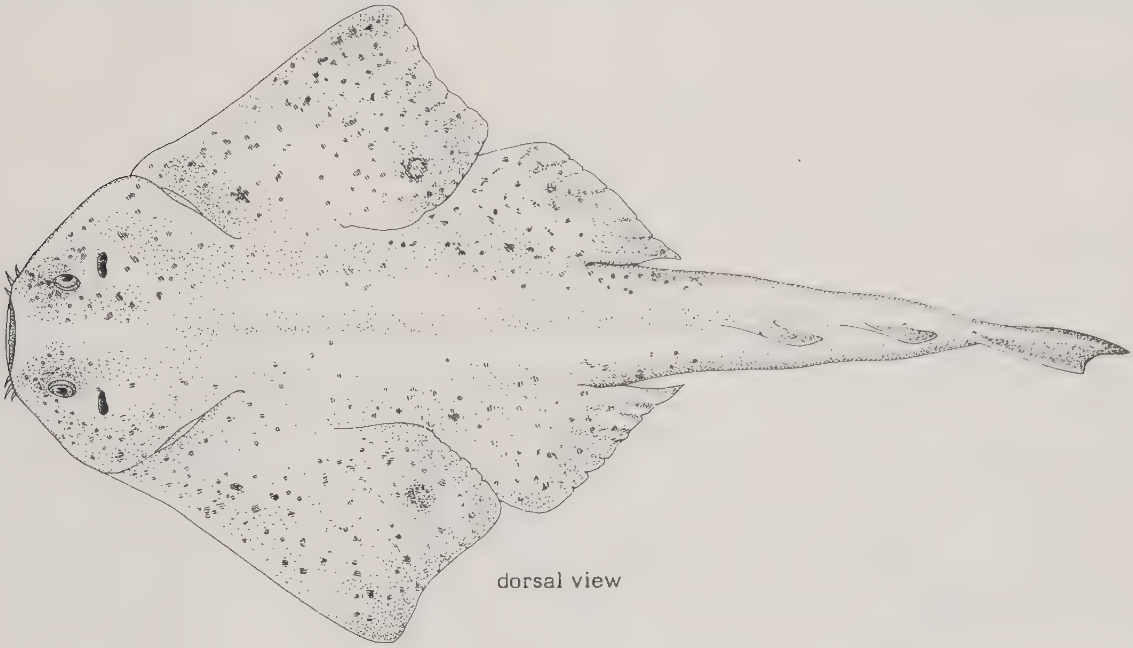
Squatina dumeril LeSueur, 1818

SQUAT Squat 2

Squatina dumeril LeSueur, 1818, J.Acad.Nat.Sci.Philad., 1(2):225, pl. 10. Holotype: Paratype or syntype in Muséum National d'Histoire Naturelle, Paris, MNHN A. 9692, 1220 mm adult male. Type Locality: East coast of North America.

Synonymy : None.

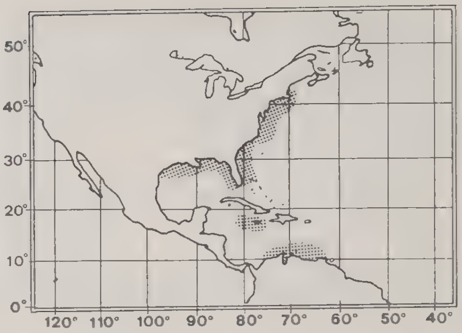
FAO Names : En - Sand devil; Fr - Ange de mer de sable; Sp - Tiburón ángel.



dorsal view

Field Marks : An angelshark with simple, tapering nasal barbels and weakly fringed or smooth anterior nasal flaps, dermal flaps on sides of head without angular lobes, large eyes with interspace between them and spiracles less than 1.5 times eye diameter, fairly broad and posteriorly angular pectoral fins, and no ocelli on body.

Diagnostic Features : Trunk moderately narrow. Anterior nasal barbels simple and with a narrow, tapering tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed or smooth; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head without triangular lobes. Pectoral fins rather broad and high, with narrowly subangular free rear tips. Moderately large spines present on midline of back and tail from head to dorsal fins and between the fin bases, and on snout and above eyes; lateral trunk denticles with broadly hooked and 3-ridged crowns. Colour: no ocelli on body.



Geographical Distribution : Western North Atlantic: Southern New England to Gulf of Mexico, Jamaica, Venezuela.

Habitat and Biology : A moderately common but rather poorly known temperate and subtropical angelshark of the Western North Atlantic continental shelf and slope, on or near the bottom from close inshore to exceptionally down to 1390 m depth. It apparently is seasonal in its presence in shallow water, and off the eastern United States apparently moves inshore in the spring and summer, and subsequently disappears, apparently into deeper water. Ovoviviparous. Eats small bottom fishes, crustaceans and bivalves. Not dangerous to people when undisturbed, but readily snaps at fishermen that catch it (hence the common name sand devil) and can inflict severe lacerations.

Size : Maximum total length about 152 cm, mature males from 92 to 107 cm.

Interest to Fisheries : Apparently not utilized by fisheries.

Literature : Bigelow & Schroeder (1948); Compagno & Vergara (1978).

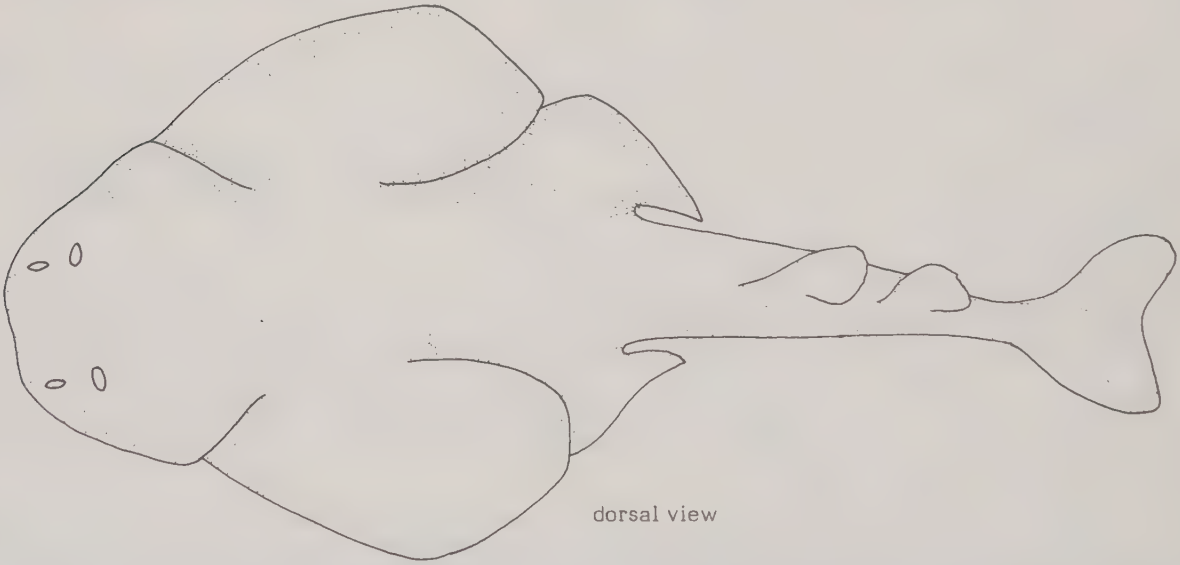
Squatina formosa Shen & Ting, 1972

SQUAT Squat 9

Squatina formosa Shen & Ting, 1972, Bull.Inst.Zool.Acad.Sin., Taiwan (Province of China), 11(1):21, fig. 4. Holotype: NTT 7212120, 337 mm female, probably immature. Type Locality: Off southwestern Taiwan Island, 20°28.0'N, 120°26.3'E, bottom at 183 m depth.

Synonymy : None.

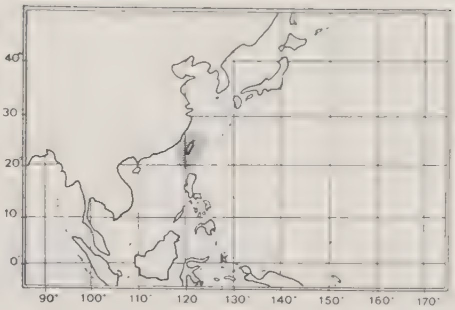
FAO Names : En - Taiwan angelshark; Fr - Ange de mer moinillon; Sp - Angelote de Taiwan.



dorsal view

Diagnostic Features : Trunk moderately narrow. Anterior nasal barbels apparently simple and with a narrow, tapering tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed or smooth; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head possibly with a triangular lobe. Pectoral fins rather broad and high, with narrowly subangular free rear tips. Spines on midline of back and tail, and on snout and between eyes small. Colour: no ocelli on body.

Geographical Distribution : Western North Pacific: Northeastern and southwestern coasts of Taiwan Island.



Habitat and Biology : A little-known angelshark of the outer continental shelf of Taiwan Island, caught on bottom at 183 to 220 m depth.

Size : Maximum total length reported 46 cm female, presumably immature.

Interest to Fisheries : None.

Literature :- Shen & Ting (1972).

Remarks : The validity of this species is uncertain: it needs to be critically compared with other western North Pacific angel sharks. It is not included in the key, and field marks are not given.

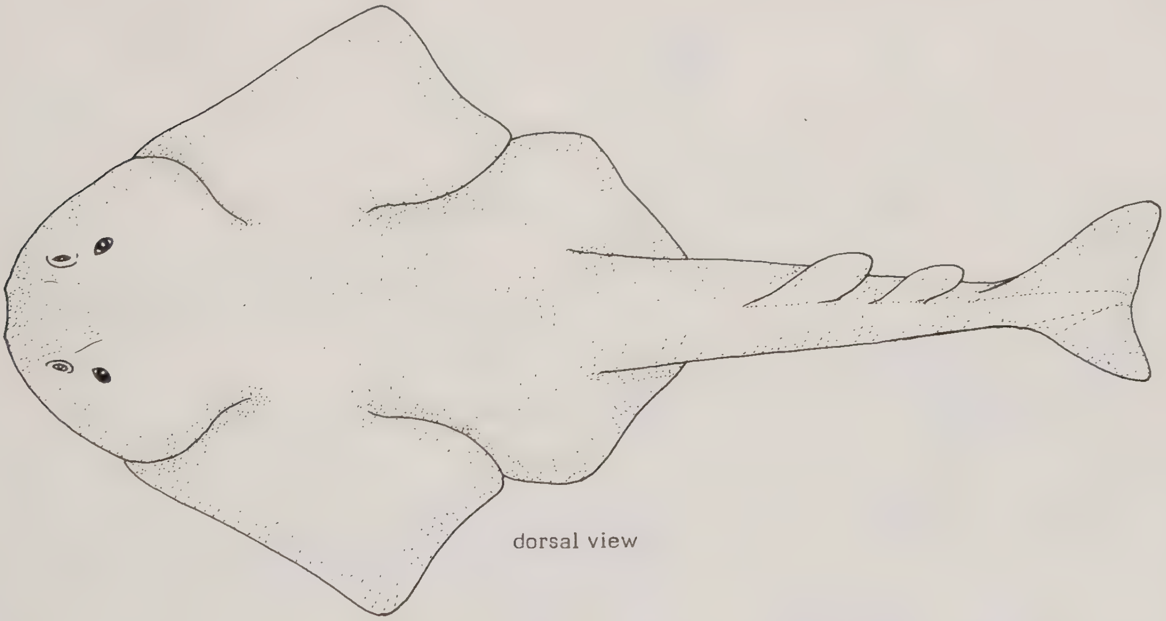
Squatina japonica Bleeker, 1858

SQUAT Squat 10

Squatina japonica Bleeker, 1858, Act.Soc.Sci.Ind.Neer.(Japon.), 3:40. Holotype: Rijksmuseum van Natuurlijke Historie, Leiden, RMNH 7416, 525 mm male. Type Locality: Nagasaki, Japan.

Synonymy : None.

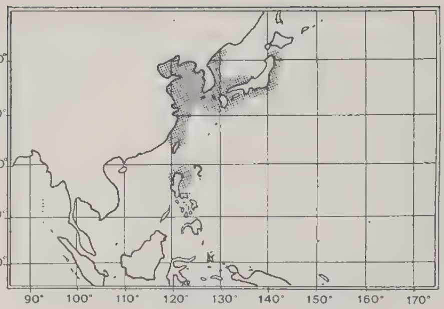
FAO Names : En - Japanese angelshark; Fr - Ange de mer Kasuzame; Sp - Angelote japonés.



dorsal view

Field Marks : An angelshark with simple, spatulate nasal barbels and weakly fringed or smooth anterior nasal flaps, dermal flaps on sides of head without angular lobes, large eyes with interspace between them and spiracles less than 1.5 times eye diameter, fairly broad and posteriorly rounded pectoral fins, and no ocelli on body.

Diagnostic Features : Trunk moderately narrow. Anterior nasal barbels simple and with a narrow, spatulate tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed or smooth; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head without triangular lobes. Pectoral fins rather broad and high, with rounded free rear tips. Moderately large spines present on midline of back and tail from head to dorsal fins and between the fin bases, and on snout and above eyes. Colour: no ocelli on body.



Geographical Distribution : Western North Pacific: Southeastern Sea of Japan to Yellow Sea, Japan, the Koreas, northern China, ?the Philippines.

Habitat and Biology : A little-known angelshark of temperate western North Pacific waters, found on or near the bottom.

Size : Maximum total length to 2 m long.

Interest to Fisheries : Details of fisheries off China, Japan and the Republic of Korea sketchy but apparently taken in large numbers off China, and used for human consumption and for preparation of shagreen for polishing and finishing woodworks.

Literature : Fowler (1941); Bigelow & Schroeder (1948).

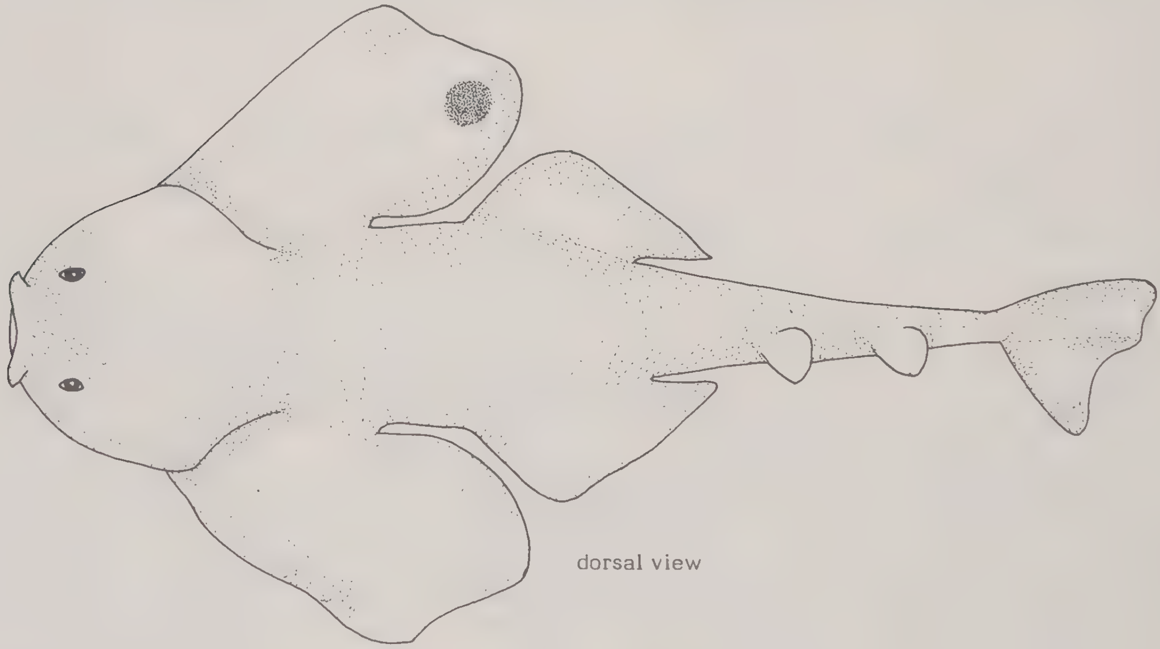
Squatina nebulosa Regan, 1906

SQUAT Squat 11

Squatina nebulosa Regan, 1906b, Ann.Mag.Nat.Hist.(Ser. 7), 18:439. Holotype: British Museum (Natural History), 580 mm. Type Locality: Japan.

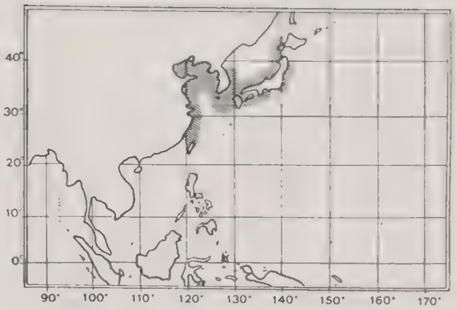
Synonymy : None.

FAO Names : En - Clouded angelshark; Fr - Ange de mer nébuleux; Sp - Angelote nebuloso.



Field Marks : An angelshark with simple, tapering nasal barbels and weakly fringed or smooth anterior nasal flaps, dermal flaps on sides of head with two angular lobes, large eyes with interspace between them and spiracles less than 1.5 times eye diameter, fairly broad and posteriorly rounded pectoral fins, and no ocelli on body.

Diagnostic Features : Trunk fairly broad. Anterior nasal barbels simple and with a narrow, tapering tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed or smooth; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head with two triangular lobes. First dorsal origin about opposite rear tips of pelvics. Pectoral fins rather broad and high, with broadly rounded free rear tips. Small spines present on midline of back and tail from head to dorsal fins and between the fin bases, and on snout and above eyes. Colour: no ocelli on body.



Geographical Distribution : Western North Pacific: Southeastern Sea of Japan to Taiwan Island, including Japan, the Koreas, China.

Habitat and Biology : A little-known temperate water angel shark of the western Pacific continental shelves, found on or near the bottom.

Size : Maximum total length in females at least 163 cm.

Interest to Fisheries : Taken off China, but details of fishery unknown; probably taken elsewhere in its range.

Literature : Fowler (1941); Bigelow & Schroeder (1948).

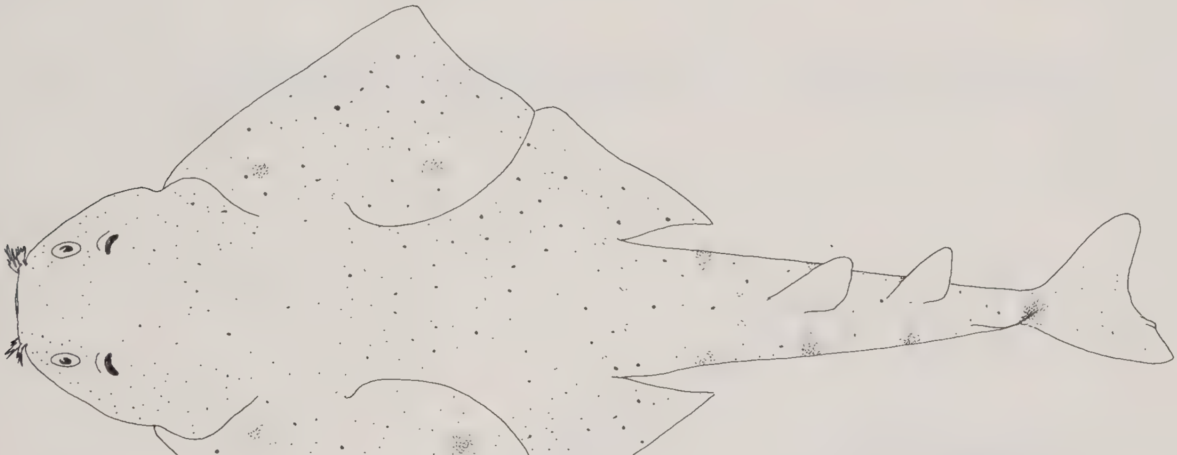
Squatina oculata Bonaparte, 1840

SQUAT Squat 3

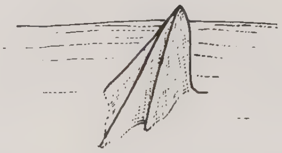
Squatina oculata Bonaparte, 1840, Icon.Faun.Ital., fasc.28, pta. 147. Holotype: None. Type Locality: Mediterranean off Italy.

Synonymy : None.

FAO Names : En - Smoothback angelshark; Fr - Ange de mer ocellé (= Ange de mer de Bonaparte); Sp - Pez ángel.



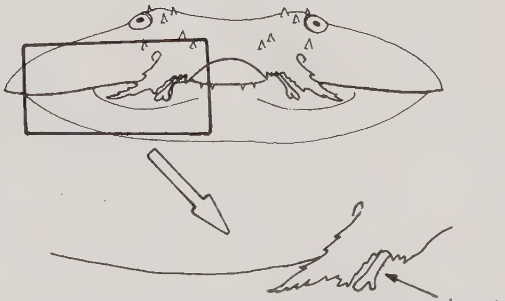
dorsal view



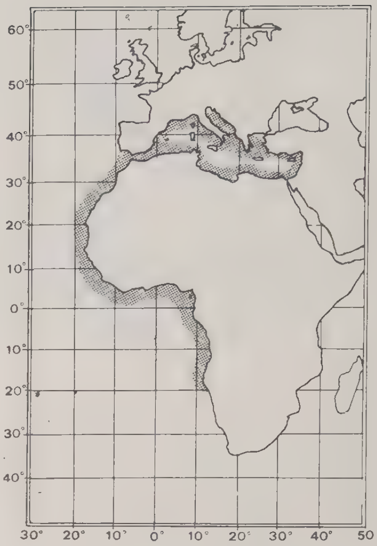
dermal denticle

Field Marks : An angelshark with large thorns on snout and above eyes but not on midback, weakly bifurcated nasal barbels and weakly fringed anterior nasal flaps, the first dorsal origin usually well behind the pelvic rear tips, and prominent white spots on body.

Diagnostic Features : Trunk rather slender. Anterior nasal barbels weakly bifurcated; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head without triangular lobes. Origin of first dorsal fin usually well behind free rear tips of pectoral fins; pectoral fins low and angular, rear tips of pectoral fins broadly subangular. Large spines present on snout and above eyes but usually absent from midback; lateral trunk denticles pointed and with three ridges. Colour: no large brown ocelli, but prominent white spots present in a symmetrical pattern on pectoral fins and on body.



frontal view of head
(showing anterior nasal flaps)



Geographical Distribution : Eastern Atlantic: Mediterranean and Morocco to Angola.

Habitat and Biology : A warm-temperate and tropical angelshark of the eastern Atlantic continental shelves and upper slopes from 20 to 500 or more metres, mostly between 50 and 100 m, deeper in tropics. Ovoviviparous. Eats small fishes, including goatfishes.

Size : Maximum total length 160 cm, adult males to at least 140 cm, size at birth about 24 to 27 cm.

Interest to Fisheries : Caught primarily in bottom trawls, but also in fixed bottom nets, on line gear, and occasionally even in pelagic trawls. Utilized fresh and dried salted for human consumption, for liver oil and hides used for leather.

Literature : Bigelow & Schroeder (1948); Poll (1950); Cadenat (1957); Maurin & Bonnet (1970); Compagno (1981).

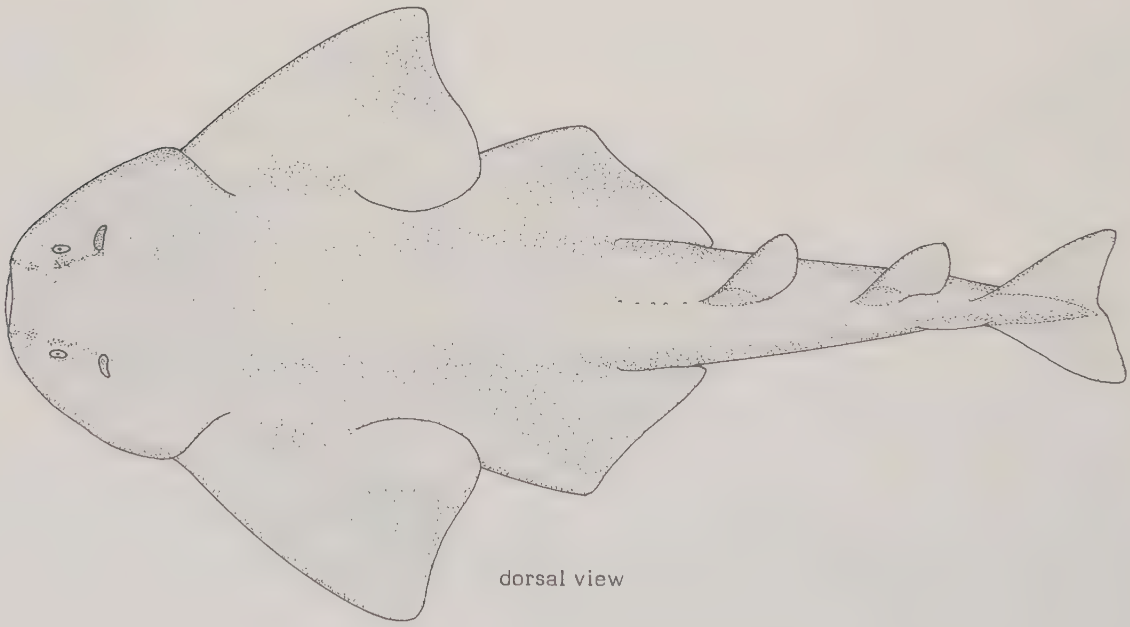
Squatina squatina (Linnaeus, 1758)

SQUAT Squat 1

Squalus squatina Linnaeus, 1758, Syst.Nat., ed. 10, 1:233. Holotype: Unknown. Type Locality: "Oceano Europaeo".

Synonymy : Squatina vulgaris Risso, 1810; Squatina angelus Blainville, 1816; Squatina laevis Cuvier, 1817; Squatina lewis Couch, 1825; ? Squalraia acephala de la Pylaie, 1835; ? Squalraia cervicata de la Pylaie, 1835; Squatina europaea Swainson, 1839.

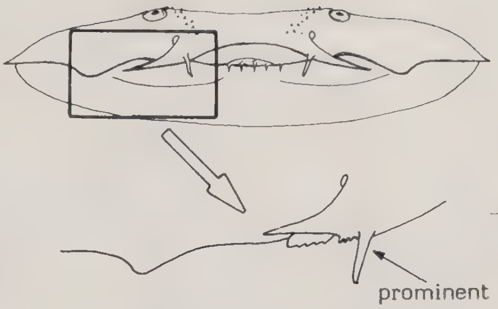
FAO Names : En - Angelshark; Fr - Ange de mer commun; Sp - Angelote.



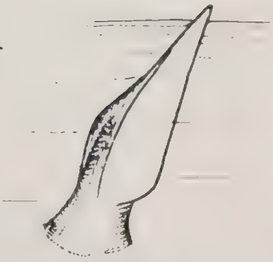
dorsal view

Field Marks : An angelshark with a broad trunk, simple, conical nasal barbels and smooth or weakly fringed anterior nasal flaps, dermal flaps on sides of head with an angular lobe, very high broad pectoral fins, and no ocelli on body.

Diagnostic Features: Trunk very broad. Anterior nasal barbels simple and with a spatulate tip; posterior margin of anterior nasal flaps between nasal barbels and tips weakly fringed; distance from eye to spiracle over 1.5 times eye diameter; dermal folds on sides of head with a single triangular lobe. Pectoral fins very high and broad, with broadly rounded rear tips. Small spines present or absent on midline of back and tail from head to dorsal fins and between the fin bases, and patches of small spines on snout and above eyes; lateral trunk denticles with very narrow, sharp-cusped crowns. Colour: no ocelli on body.

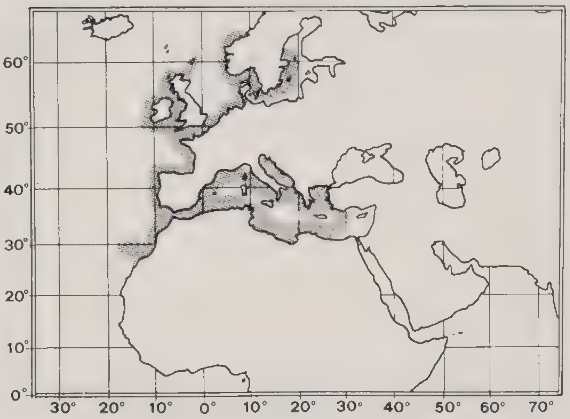


frontal view of head
(showing anterior nasal flaps)



dermal denticle

Geographical Distribution: Eastern North Atlantic: Southern Norway, Sweden and Shetland Island to Morocco and West Sahara, Canary Islands, Mediterranean.



Habitat and Biology: A temperate-water bottom-dwelling angelshark of the European and North African continental shelves, on or near the bottom from close inshore to at least 150 m depth. This shark prefers mud or sandy bottom, where it lies buried with hardly more than its eyes protruding. It is nocturnal and can be found swimming strongly up off the bottom, but is torpid in the daytime and rests on the bottom. In the northern parts of its range the angelshark is seasonally migratory, and makes northward incursions during the summer.

This shark is ovoviviparous, with moderate-sized litters of 9 to 20 young. The angelshark feeds primarily on bony fishes, especially flatfishes but also other demersal fishes and skates, crustaceans and molluscs.

Size: Maximum total length at least 183 cm and possibly to 244 cm; adult males reaching 183 cm, females maturing at 126 to 167 cm; size at birth about 24 to 30 cm.

Interest to Fisheries: Caught in bottom trawls, and utilized fresh and dried salted for human consumption, and possibly for oil and fishmeal.

Literature: Garman (1913); Bigelow & Schroeder (1948); Wheeler (1978); Compagno (1981).

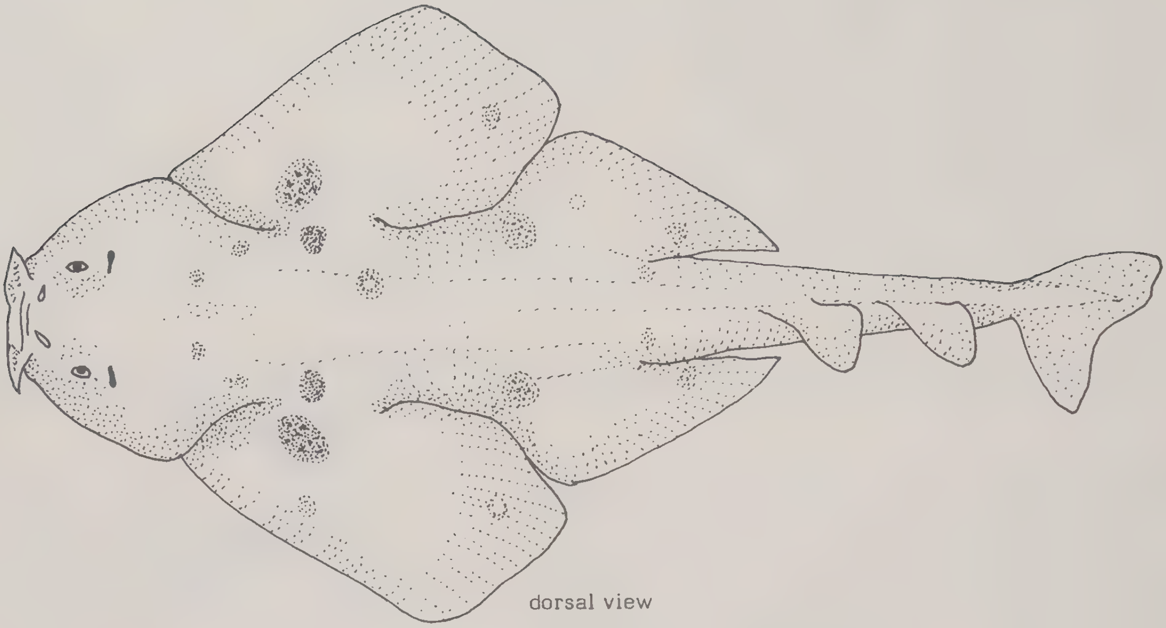
Squatina tergocellata McCulloch, 1914

SQUAT Squat 12

Squatina tergocellata McCulloch, 1914, Zool.Result.Fish.Exp.Endeavour, 2:84, fig. 2, pl. 15. Holotype: Female, 420 mm fork length. Type locality: Great Australian Bight, from 293 to 365.

Synonymy: None.

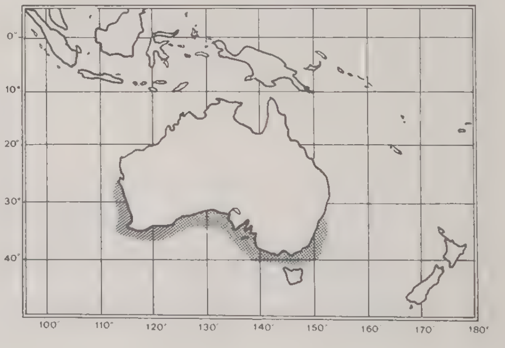
FAO Names: En - Ornate angelshark; Fr - Ange de mer bourgeois; Sp - Angelote ornamentado.



Field Marks : An angelshark with strongly fringed nasal barbels and anterior nasal flaps, dermal flaps on sides of head without angular lobes, large eyes with interspace between them and spiracles less than 1.5 times eye diameter, fairly broad and rounded pectoral fins, and prominent large ocelli on body.

Diagnostic Features : Trunk relatively narrow. Anterior nasal barbels and posterior margins of anterior nasal flaps strongly fringed; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head without triangular lobes. Origin of first dorsal fin about opposite inner margins of pelvic fins; pectoral fins moderately high and angular, with broadly rounded free rear tips. Small spines present on midline of back and tail from head to dorsal fins and between the fin bases; moderate-sized spines present on snout and above eyes. Colour: very large and prominent ocelli present on body.

Geographical Distribution : Western South Pacific: Australia (New South Wales, Western and South Australia).



Habitat and Biology : A little-known, temperate water angel shark of the Australian continental shelf and upper slope, on or near the bottom at depths of 128 to 366 m.

Size : Maximum uncertain, largest reported 55 cm total length (probably immature).

Interest to Fisheries : None at present.

Literature : Whitley (1940); Bigelow & Schroeder (1948).

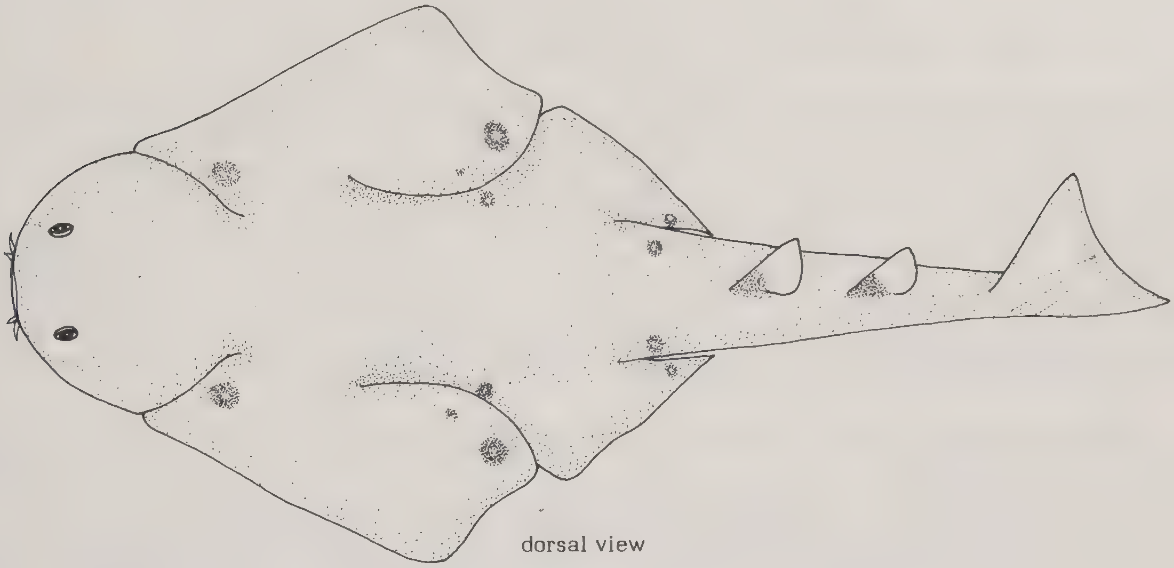
Squatina tergocellatoides Chen, 1963

SQUAT Squat 13

Squatina tergocellatoides Chen, 1963, Biol.Bull.Dep.Biol.Coll.Sci.Tunghai Univ.(Ichthyol.Ser. 1), (19):98, fig. 1. Holotype: Tunghai University, THUP 00348, 265 mm female. Type Locality: Taiwan Island Straits.

Synonymy : None.

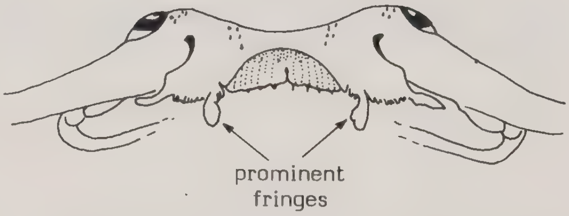
FAO Names : En - Ocellated angelshark; Fr - Ange de mer dandy; Sp - Angelote ocelado.



dorsal view

Field Marks : An angelshark with weakly fringed nasal barbels and anterior nasal flaps, and no ocelli on body.

Diagnostic Features : Anterior nasal barbels strongly fringed; posterior margin of anterior nasal flaps between nasal barbels and tips strongly fringed; distance from eye to spiracle less than 1.5 times eye diameter; dermal folds on sides of head with 2 or 3 prominent triangular lobes. Origin of first dorsal fin usually about opposite pelvic rear tips; pectoral fins rather long and low, free rear tips narrowly subangular. Large spines present on midline of back and tail from head to dorsal fins and between the fin bases, also on snout and above eyes; lateral trunk denticles pyramidal, not hooked. Colour: no ocelli on body.



frontal view of head
(showing anterior nasal flaps)

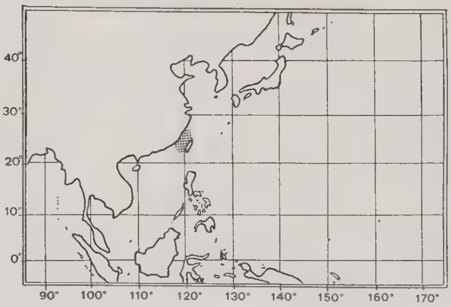
Geographical Distribution : Western North Pacific: Taiwan Straits.

Habitat and Biology : A little-known angelshark from Taiwan Island waters, details of habitat and biology unknown.

Size : Maximum total length at least 63 cm (holotype and only known specimen).

Interest to Fisheries : None at present.

Literature : Chen (1963).



6. ORDER HETERODONTIFORMES - BULLHEAD SHARKS

Order Heterodontiformes Compagno, 1973c, J.Linn.Soc.(Zool.), 53, suppl. 1.

Synonymy : Order Asterospondyli: Fowler, 1941 (in part); Smith, 1949 (in part). Order Asterospondyli, Suborder Proarthri: Jordan & Evermann, 1896. Order Centraciones, Suborder Prosarthri: Jordan, 1923 (in part). "Group" Centraciontoidei: Garman, 1913. Suborder Galei: Gill, 1872 (in part). Order Heterodontea: White, 1936, 1937 (in part); Whitley, 1940. Suborder Heterodonti: Goodrich, 1909 (in part). Order Heterodontida: Fowler, 1966a (in part). Order Heterodontiformes: Berg, 1940 (in part), Berg & Svedovidov, 1955 (in part), Arambourg & Bertin, 1958; Patterson, 1967; Lindberg, 1971; Rass & Lindberg, 1971; Applegate, 1974; Nelson, 1976; Chu & Wen, 1979. Suborder Heterodontiformes: Bertin, 1939; Budker & Whitehead, 1971. Order Heterodontoidea: Schultz & Stern (1948). Suborder Heterodontoidea: Romer, 1945 (in part); Bigelow & Schroeder, 1948. Suborder Heterodontoidei: Romer, 1966 (in part). Order Hexanchida, Suborder Heterodontoidei: Glikman, 1967 (in part). Suborder Plagiostomi Asterospondyli: Hasse, 1879 (in part). Order Prosarthri: Gill, 1893. Order Selachii: Blot, 1969 (in part). Suborder Squali: Gill, 1862 (in part). Suborder Squaloidea: Norman, 1966 (in part). "Division" Squaloidei: Regan, 1906 (in part). Suborder Squaloidei: Engelhardt, 1913 (in part).

Diagnostic Features : Trunk cylindrical or slightly compressed, not depressed and raylike. Head conical and slightly elevated, not depressed and laterally expanded; 5 pairs of gill slits present on sides of head, the last three above the pectoral fin bases; spiracles present and small, behind and below the eyes; nostrils without barbels but with strong nasoral grooves and circumnarial grooves, connected to mouth, with anterior nasal flaps elongated posteriorly and reaching mouth; eyes on dorsolateral surface of head, without nictitating lower eyelids; snout very short and bluntly rounded, not sawlike and without rostral barbels; mouth moderate, arched and short, well in front of eyes; labial furrows very large, present on both jaws; teeth strongly differentiated along jaws, with anterior teeth small and cuspidate and posteriors enlarged, acuspidate and molariform; no small intermediate teeth or a gap between anterior and lateroposterior teeth in upper jaw. Two dorsal fins, each with a stout fin spine, the first with its origin over the pectoral bases or inner margins; pectoral fins moderately large, not raylike and without triangular anterior lobes; pelvic fins moderately large, with vent continuous with their inner margins; anal fin present; caudal fin with a moderately long dorsal lobe and moderately long ventral lobe, the latter shorter than the dorsal lobe. Vertebral axis raised into the dorsal caudal lobe; intestinal valve of spiral type.

6.1 FAMILY HETERODONTIDAE Gray, 1851

HET

Tribe Heterodontina Gray, 1851 (Family Squalidae), List spec.coll.British Mus., pt. 1, Chondropterygii, 65.

Synonymy : Subfamily Cestraciontini Bonaparte, 1838 (Family Squalidae).

FAO Names : En - Bullhead sharks, Horn sharks; Fr - Requins dormeurs; Sp - Dormilones.

Field Marks : These small sharks are easily recognizable, being the only living ones with dorsal fin spines and an anal fin. The piglike snout, small anterior mouth, enlarged molariform teeth in the back of the mouth, supraorbital ridges, rough skin, paddlelike paired fins, and enlarged first gill slits are characteristic of the family.

Habitat, Distribution and Biology : These are common, sluggish, warm-temperate and tropical bottom sharks of water above 21°C, mostly confined to the continental and insular shelves and uppermost slopes of the western and eastern Pacific and western Indian Ocean. They occur from the intertidal to 275 m depth, but most are in shallower water than 100 m. As far as is known, these are night-active sharks, slowly swimming and crawling on rocky, kelp-covered and sandy bottom. Some species at least favour rocky crevices and caves, where they spend the day resting. At least one species is migratory when adult, and returns to its breeding sites each year after long migrations.

These sharks are oviparous, producing eggs in unique, large, spiral-flanged egg cases. These are laid in specific 'nesting' sites in at least two species. Eggs may take over 5 months to hatch, and young hatch at a large size, over 14 cm.

Bullhead sharks primarily feed on benthic invertebrates. Sea urchins (echinoids) are a favorite food, but crabs, shrimps and other crustaceans, abalone, top shells and other marine gastropods, oysters, polychaetes and more rarely small fish are also eaten.

Several species of bullhead sharks have been kept in aquaria, where they have proved to be extremely hardy and can live for over a decade. Mating, egg-laying, hatching of eggs, and growth to maturity can occur in captivity.

Some bullhead sharks are often encountered by divers, who commonly harass them. Although regarded as harmless, these sharks can and do snap when provoked and occasionally pursue and bite their tormentors.

Interest to Fisheries : These sharks are of minimal interest to fisheries, being caught as a bycatch of bottom trawl and line fisheries and utilized for human consumption and for fishmeal. They are commonly caught by divers and in sportsfisheries.

Remarks : The systematics of the family follows Taylor's (1972) revision. An earlier review of the family is by Smith (1942).

Heterodontus Blainville, 1816

HET Het

Genus : Subgenus *Heterodontus* Blainville, 1816 (genus Squalus Linnaeus, 1758), *Bull.Sci.Soc.Philomat.Paris*, 8:121.

Type Species : *Squalus philippi* Bloch & Schneider, 1801, by monotypy, a junior synonym of *Squalus portus jacksoni* Meyer, 1793.

Synonymy : Genus *Cestracion* Oken, 1817; Genus *Centracion* Gray, 1831; Genus *Centralion* Müller & Henle, 1838 (error ?); Genus *Gyropleurodus* Gill, 1862; Genus *Tropidodus* Gill, 1862; Genus *Molochophrys* Whitley, 1931; Subgenus *Wuia* Fowler, 1934 (Genus *Heterodontus* Blainville, 1816); Genus *Tropidodus* Beebe & Tee-Van, 1941 (error); Genus *Centraction* Fowler, 1941 (error); Genus *Cetracion* Fowler, 1941 (error).

Key to Species :

1a. Supraorbital ridges very high .... ***H. galeatus***

1b. Supraorbital ridges moderate to low

  2a. First dorsal origin behind pectoral fin bases .... ***H. quoyi***

  2b. First dorsal origin over pectoral fin bases

    3a. Body and fins spotted

      4a. Body and fins with white spots. Anal fin apex well anterior to lower caudal origin when laid back .... ***H. ramalheira***

      4b. Body and fins with dark spots. Anal fin apex reaching lower caudal origin when laid back

        5a. Back and sides with small dark spots less than a third of eye diameter; no light bar on interorbital surface of head .... ***H. francisci***

        5b. Back and sides with larger dark spots a half eye diameter or more; a light bar on interorbital surface of head .... ***H. mexicanus***

    3b. Body and fins striped or banded

      6a. Body with a harness pattern of dark stripes .... ***H. portusjacksoni***

      6b. Body with 7 to 12 vertical dark bands, not arranged in a harness pattern

        7a. Ground colour white or cream with narrow, discrete brown or black vertical bands; distance from anal base to lower caudal origin over twice anal base .... ***H. zebra***

        7b. Ground colour tan to brown with broad, diffuse-edged brown vertical bands; distance from anal base to lower caudal origin less than twice anal base .... ***H. japonicus***

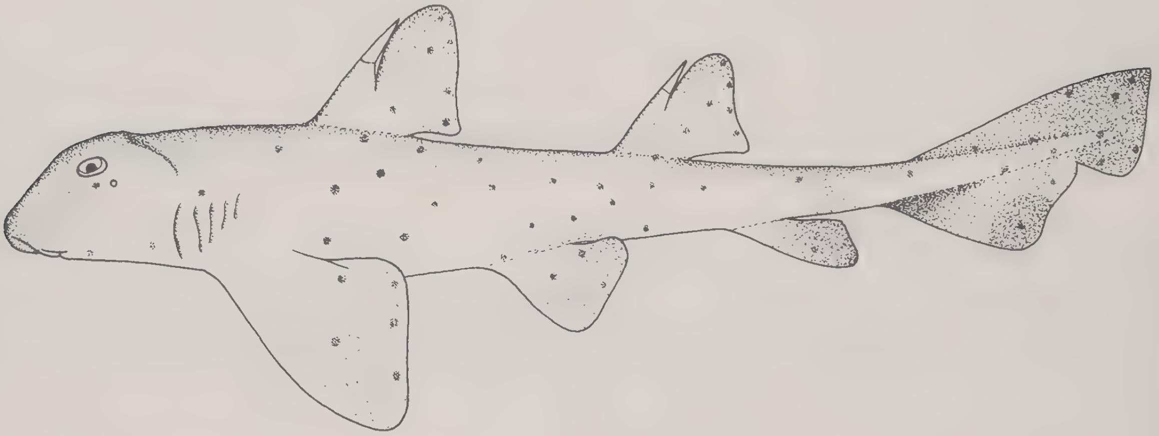
Heterodontus francisci (Girard, 1854)

HET Het 2

Cestracion francisci Girard, 1854, Proc.Acad.Nat.Sci.Philadelphia, 7(6):196. Holotype: US National Museum of Natural History, apparently lost? Type Locality: Monterey Bay, California.

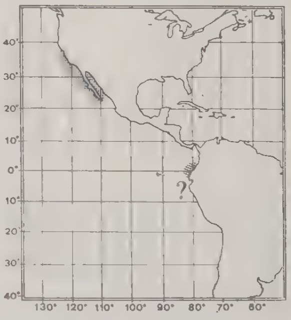
Synonymy : Heterodontus californicus Herald, 1961 (error for H. francisci).

FAO Names : En - Horn shark; Fr - Requin dormeur cornu; Sp - Dormilón cornudo.



Field Marks : Dorsal fins with spines, anal fins present, colour patterns of small dark spots less than 1/3 eye diameter on light background, no light bar on interorbital space between supraorbital ridges, first dorsal origin over pectoral bases.

Diagnostic Features : Supraorbital ridges moderately high, abruptly ending posteriorly; molariform teeth in rear of mouth not greatly expanded and rounded, with a strong medial ridge. First dorsal origin over pectoral bases; apex of anal fin falling opposite or slightly behind lower caudal origin when laid back; anal base length equal or less than distance between anal insertion and lower caudal origin. Colour dark to light grey or brown with scattered small spots on fins and body, less than 1/3 length of eye; no light bar on interorbital space. Egg cases with paired simple flat spiral flanges, diagonal to case axis and with 5 turns visible on sides, case apex without tendrils.



Geographical Distribution : Warm-temperate and subtropical waters of the eastern Pacific: Central California to Gulf of California, and probably Ecuador and Peru.

Habitat and Biology : A common benthic and epibenthic shark, found on the eastern Pacific continental shelf most abundantly at depths of 2 to 11 m but ranging from the intertidal down to at least 150 m. Found on rocky bottom, kelp beds, sandy draws between rocks, and on sand flats. On rocks it often occurs in deep crevices and small caves, and ventures far into large underwater caverns.

The horn shark is sluggish, nocturnal, and mostly solitary. It is seldom seen moving during the daytime but commonly has its head in a crevice. Shortly after dusk this shark becomes active and apparently feeds mostly at night, but ceases activity after dawn. Experimentation with captive horn sharks indicates that their diel activity pattern is controlled by light intensity. The broad, muscular paired fins of the horn shark are used as limbs for clambering on the bottom, and are highly mobile and flexible. Swimming is slow and sporadic.

Courtship and copulation has been observed in captivity. The male horn shark chases the female until the latter is ready, then both drop to the bottom. The male grabs the female's pectoral fin with his teeth and inserts a single clasper in her cloaca; copulation lasts 30 to 40 minutes. One to two weeks later eggs are laid by captive females, one of which laid 2 eggs per day at 11 to 14 intervals for 4 months. In nature these sharks mate in December or January and females drop eggs in February to April. Females normally deposit eggs under rocks or in crevices between them, but in captivity they drop eggs on the bottom where the contents of egg cases may be subsequently sucked out and eaten by these sharks. Eggs can be readily hatched in aquaria and take 7 to 9 months to hatch; the young begin to feed a month after hatching.

The horn shark feeds on benthic invertebrates, especially sea urchins (echnoids), crabs and possibly abalone, but less commonly on small fishes. Horn sharks are harmless and are often harassed and grabbed by divers, but when provoked may swim after their assailants and bite them.

Size : Maximum total length 122 cm but most adults below 97 cm; males mature at 58 to 71 cm, females above 58 cm. Size at hatching 15 or 16 cm.

Interest to Fisheries : Minimal, probably utilized for fishmeal as a bycatch of the shrimp fishery and other bottom-trawling operations in Pacific Mexican waters. It is often captured by divers for sport and for its large fin spines, which are made into jewelry; decreases in numbers of horn sharks have been noted in areas with intense diver activity in southern California.

Literature : Beebe & Tee-Van (1941); Smith (1942); Roedel & Ripley (1950); Limbaugh (1963); Nelson & Johnson (1970); Miller & Lea (1972); Taylor (1972); Feder, Turner & Limbaugh (1974); Chirichigno (1980); Compagno in Eschmeyer, Herald & Hamman (1983).

Heterodontus galeatus (Günther, 1870)

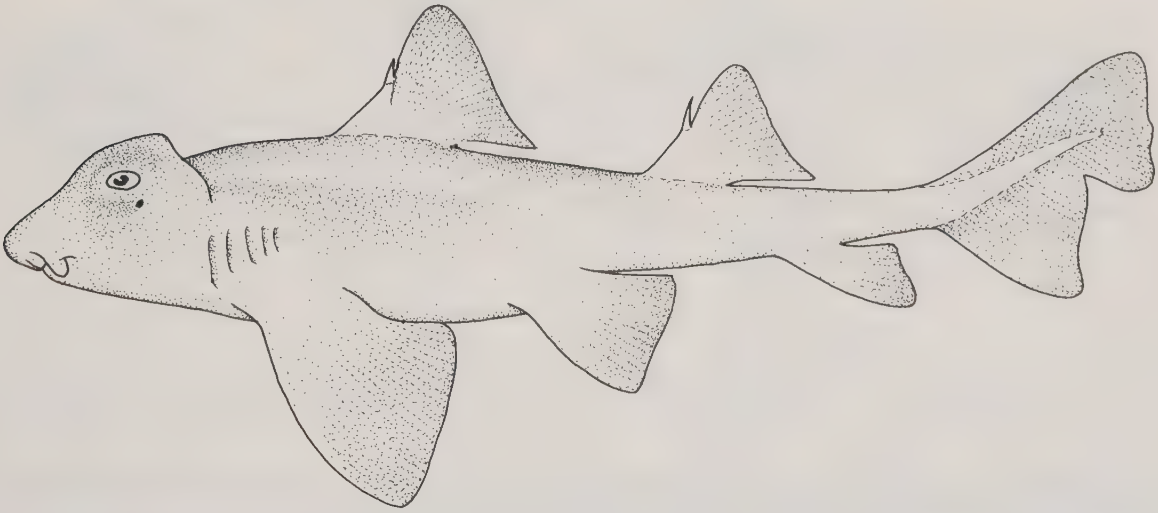
HET Het 3

Cestracion galeatus Günther, 1870, Cat.Fish.British Mus., 8:416. Holotype: British Museum (Natural History), about 640 mm long. Type Locality: Australia.

Synonymy : None.

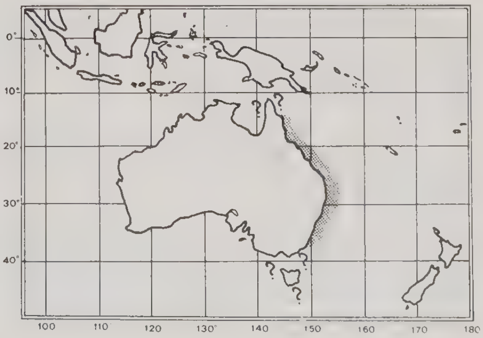
Other Scientific Names Recently in Use : Molochophrys galeatus (Günther, 1870).

FAO Names : En - Crested bullhead shark; Fr - Requin dormeur à crête; Sp - Dormilón carenado.



Field Marks : Dorsal fins with spines, anal fin present, supraorbital ridges greatly enlarged, colour pattern of obscure dark broad bands on head, back and tail.

Diagnostic Features : Supraorbital ridges very high, more prominent than any other Heterodontus, abruptly ending behind eyes; molariform teeth in rear of mouth not greatly expanded and rounded, with strong medial ridges. First dorsal origin over pectoral bases; apex of anal fin reaches lower caudal origin; anal base between 1 and 2 times in space between anal base and lower caudal origin. Colour light brown with broad blackish bands or saddle-markings on head, on back at base of first dorsal, and on tail just behind second dorsal, these rather obscure and poorly defined. Egg cases with simple, flat, narrow paired spiral flanges, diagonal to case axis and with 6 or 7 turns visible on sides, case apex with long, slender tendrils.



Geographical Distribution : Western South Pacific: Australia (Queensland, New South Wales, ?Tasmania).

Habitat and Biology : A moderately common benthic and epibenthic shark of the southern Australian continental shelf at moderate depths, ranging from close inshore to 93 m. This shark often wedges its way between rocks in search of prey. The egg cases, with long tendrils, are dropped by females in seaweeds at about 24 m depth on the bottom, during July and August, and hatch after at least 5 months. Eggs are commonest in August and September but are found throughout the year. In captivity a newly hatched female matured and began to lay eggs after 11.8 years. The crested bullhead shark feeds primarily on sea urchins (echinoids), but also crustaceans, molluscs and small fishes.

Size : Maximum total length said to 152 cm, but most below 122 cm. Young hatch at about 17 cm.

Interest to Fisheries : Minimal, taken by bottom trawlers.

Literature : Whitley (1940); Fowler (1941); Smith (1942); McLaughlin & O'Gower (1971); Taylor (1972).

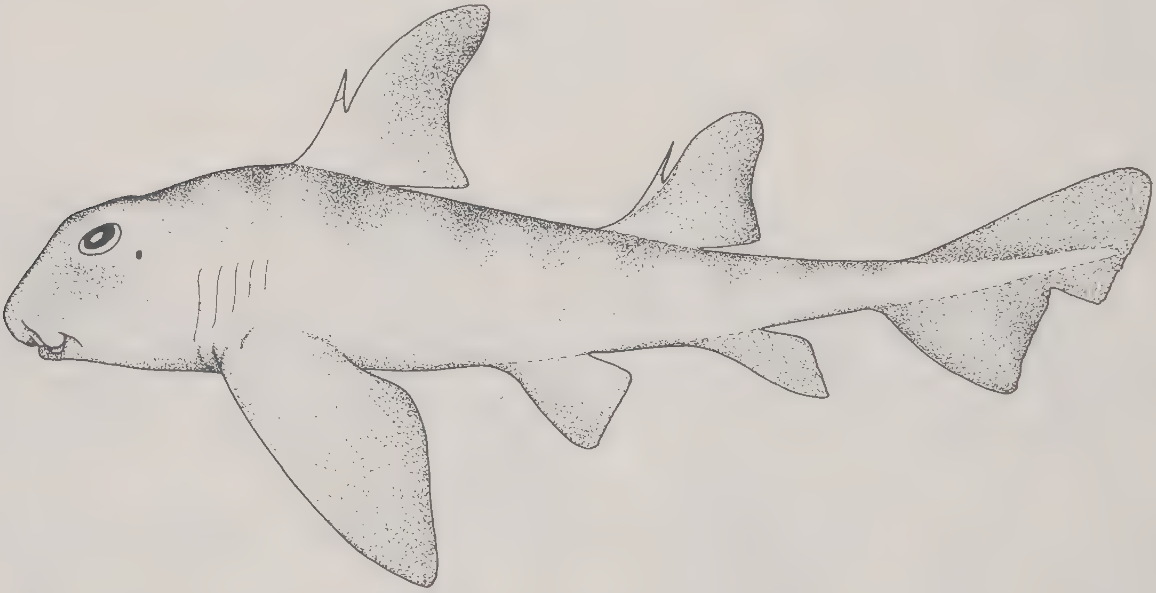
Heterodontus japonicus (Maclay & Macleay, 1884)

HET Het 4

Cestracion japonicus Maclay & Macleay, 1884, *Proc.Linnean Soc.New South Wales*, 1884, 8(4):428, pl. 20. Holotype: Australian Museum, Sydney, female. Type Locality: Tokyo, Japan.

Synonymy : ? *Cestracion philippi* var. *japonicus* Dumeril, 1865 (see Taylor, 1972).

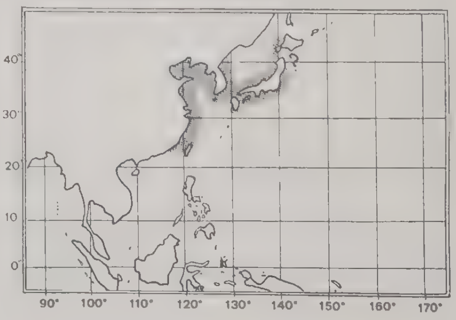
FAO Names : En - Japanese bullhead shark; Fr - Requin dormeur nekozame; Sp - Dormilón japonés.



Field Marks : Dorsal fins with spines, anal fin present, first dorsal origin over pectoral bases, colour pattern of 12 broad, irregular-edged, dark saddle-marks on a light background.

Diagnostic Features : Supraorbital ridges low, not abruptly ending behind eyes; molariform teeth in rear of mouth greatly expanded and rounded, without medial ridges. First dorsal origin over pectoral bases; apex of anal fin falling well short of lower caudal origin; anal base nearly or quite 2 times in space between anal base and lower caudal origin. Colour light brown with broad, dark brown saddle-marks. Egg cases with simple, flat, broad paired spiral flanges, diagonal to case axis and with 3 turns visible on sides, case apex with very short tendrils.

Geographical Distribution : Western North Pacific: Off Japan, Korean Republic, northern China including Taiwan Island.



Habitat and Biology : A common, temperate-water bullhead shark of the western North Pacific continental shelf, occurring at moderate depths of 6 to 37 m, on or near the bottom. It prefers rocky and kelp-covered bottom.

This is a sluggish, slow-swimming shark, easily caught by divers. It slowly explores the bottom, swimming and 'walking' with its mobile paired fins.

Oviparous, laying its large spiral-cased eggs among rocks or in kelp, at depths of about 8 or 9 m; several females may lay their eggs in a single site, termed 'nests', although these apparently do not guard these sites after laying. In Japanese waters eggs are dropped from March through September, most abundantly in March through April; each female usually lays two eggs at a time, for 6 to 12 spawnings. Eggs hatch in about a year.

The Japanese bullhead shark feeds on crustaceans, molluscs (including top shells), small fishes and sea urchins. It can protrude its jaws a considerable distance while grabbing prey.

Size : Maximum total length about 120 cm, males adult at 69 cm. Size at hatching about 18 cm.

Interest to Fisheries : Probably minimal, caught and eaten in Japan and presumably elsewhere in its range.

Literature : Fowler (1941); Smith (1942); McLaughlin & O'Gower (1971); Taylor (1972).

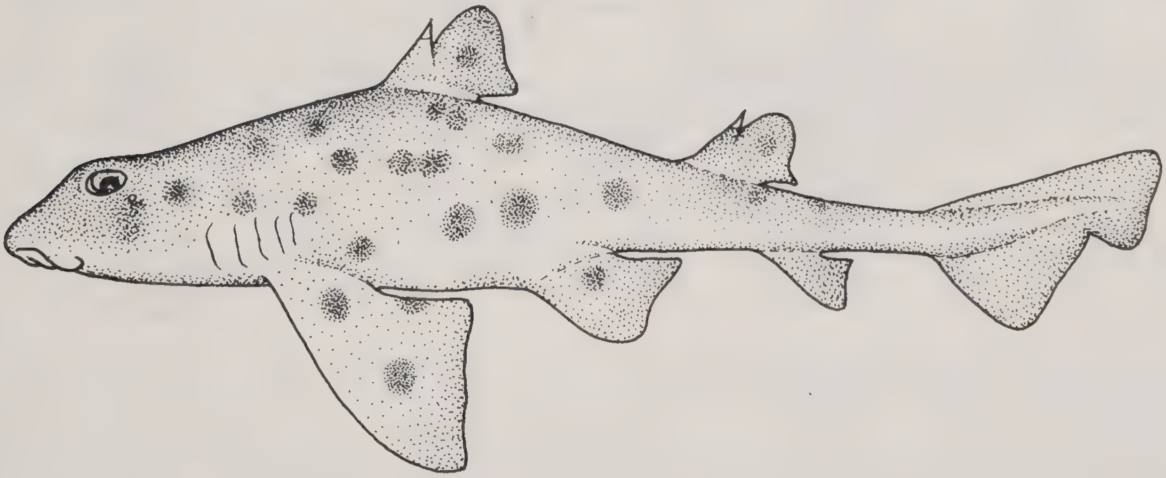
Heterodontus mexicanus Taylor & Castro-Aguirre, 1972

HET Het 5

Heterodontus mexicanus Taylor & Castro-Aguirre, 1972, An.Esc.Nac.Cienc.Biol.Mexico, 19:125, fig. 1-5, 8-9. Holotype: Scripps Institution of Oceanography, SIO 70 to 90, 610 mm adult female. Type Locality: Ceiro Colorado, Sonora, Mexico, Gulf of California.

Synonymy : None.

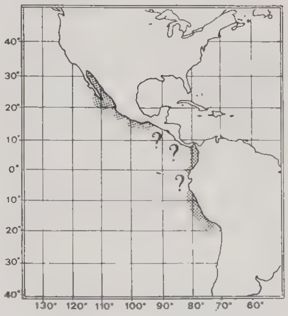
FAO Names : En - Mexican hornshark; Fr - Requin dormeur buffle; Sp - Dormilón búfalo.



Field Marks : Dorsal fins with spines, anal fin present, colour pattern of large dark spots 1/2 eye diameter or more on light background, a light bar present on interorbital space between supraorbital ridges, first dorsal origin over pectoral bases.

Diagnostic Features : Supraorbital ridges low, not abruptly ending behind eyes; molariform teeth in rear of mouth not greatly expanded and rounded, with strong medial ridges. First dorsal origin over pectoral bases; apex of anal fin reaches lower caudal origin when laid back; anal base length between 1 and 2 times in space between anal insertion and lower caudal origin. Colour light grey-brown with scattered large black spots on fins and body, these usually half eye diameter or more, and a light transverse band between supraorbital ridges on interorbital space. Egg cases with thick, T-shaped paired spiral flanges, transverse to case axis and with 5 turns visible on sides, case apex with very long tendrils.

Geographical Distribution : Eastern Pacific: From southern Baja California, the Gulf of California, and Pacific Mexico southward to Guatemala, the Gulf of Panama, Colombia, probably Ecuador, and Peru.



Habitat and Biology : A warm-temperate and tropical bullhead shark of littoral continental waters, found on rocky bottom and on sandy areas from close inshore down to at least 20 m depth. Oviparous. The long tendrils and rigid, T-shaped spiral flanges on the egg-cases of this shark suggest that wedging of the eggs in crevices through the action of flexible flanges has been replaced by anchoring of the cases to the substrate by the tendrils, unlike other bullhead sharks with flexible-flanged eggs. The heavy T-flanges may serve instead to protect the egg from impacts and egg-predators.

Size : Maximum size 70 cm, matures at a size above 55 cm; young hatch at 14 cm.

Interest to Fisheries : Minimal; small numbers are taken as a bycatch of the shrimp fishery in Mexico and processed into fishmeal along with other sharks.

Literature : Taylor & Castro-Aguirre (1969); Taylor (1972); Chirichigno (1980).

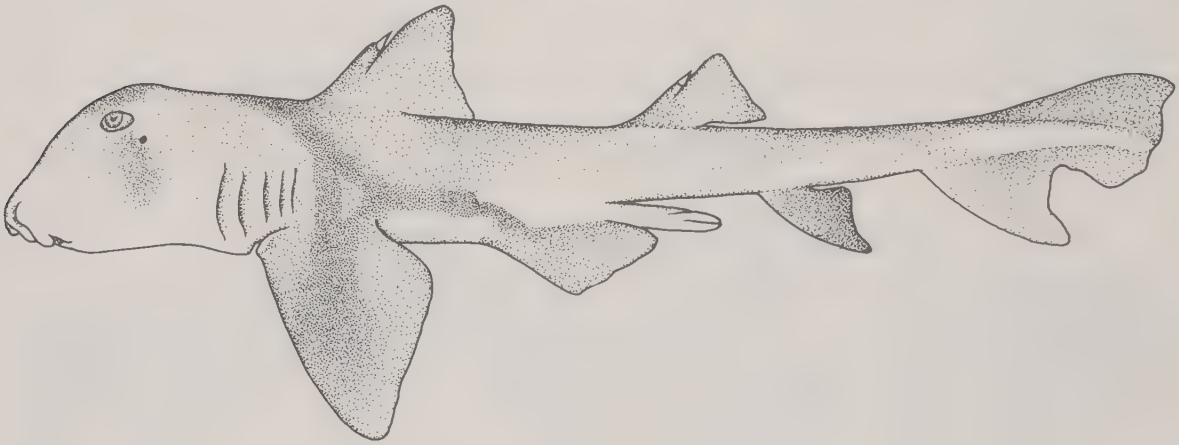
Heterodontus portusjacksoni (Meyer, 1793)

HET Het 6

Squalus portusjacksoni Meyer, 1793, *Syst.Summar.Zool.Entdeck.Neuholland, Afrika*, 71. Holotype: None. Type Locality: Botany Bay, New South Wales, Australia.

Synonymy : *Squalus jacksoni* Suckow, 1799 (also *S. jacksonii* Turton, 1806); *Squalus philippi* Bloch & Schneider, 1801; *Squalus philippinus* Shaw, 1804; *Cestracion heterodontus* Sherrard, 1896; *Heterodontus bonaespei* Ogilby, 1908.

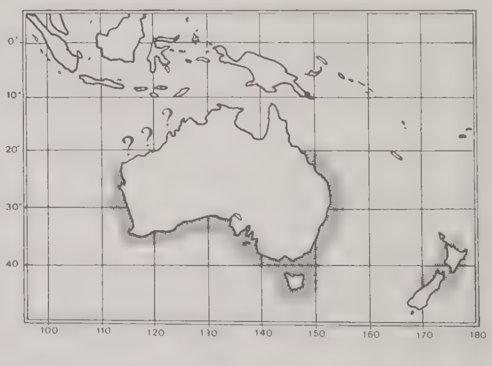
FAO Names : En - Port Jackson shark; Fr - Requin dormeur taureau; Sp - Dormilón toro.



Field Marks : Dorsal fins with spines, anal fin present, colour pattern with a conspicuous set of harness-like narrow dark stripes on the back, unique to the species.

Diagnostic Features : Supraorbital ridges low, not abruptly ending behind eyes; molariform teeth in rear of mouth greatly expanded and rounded, without medial ridges. First dorsal origin over pectoral bases; apex of anal fin falling well short of lower caudal origin; anal base about 3 times in distance from anal insertion to lower caudal origin. Colour grey to light brown or whitish with a prominent black bar across head and down cheeks, a triangular black harness-like set of bars converging on the sides and back from the first dorsal origin, pectoral and pelvic bases, and a horizontal black stripe on the sides of the back and tail. Egg cases with simple, flat, broad paired spiral flanges, diagonal to case axis and with 4 or 5 turns visible on sides, case apex with very short tendrils.

Geographical Distribution : Western South Pacific: Temperate and subtropical Australia (southern Queensland, New South Wales, Victoria, Tasmania, South and Western Australia), New Zealand (a single record, possibly as a straggler from Australia).



Habitat and Biology : A common littoral, nocturnal bottom shark of the Australian continental shelves, ranging from close inshore in the intertidal to at least 172 m. Underwater observation and tagging of this species has elucidated its lifehistory to a degree attained with few other species. While inshore, the Port Jackson shark favours caves with sandy floors and open trenches of shallow rocky reefs as resting places, and almost all individuals in a given area will be found resting in relatively few of such sites. Strong selections shown for favoured sites, and superficially identical sites nearby may have few or no sharks.

Pronounced fluctuations in abundance have been noted on shallow reefs off New South Wales, directly correlated with seasonal influxes of adults for breeding and inversely correlated by seasonal variations in temperature. Favoured resting sites may have up to 16 sharks occupying them. Data from tagging suggests that seasonal reef populations are in a state of continuous flux, with individuals moving in and out of their favoured reefs throughout the breeding season. Apparently individuals are capable of homing to favoured resting sites after ranging considerable distances away from them during the breeding season.

Breeding is seasonal, and development is oviparous. Mature females accompanied by some males move onto inshore reefs in late July and August in the Sydney area (New South Wales), and probably mating occurs at this time. Most mature males remain in deeper water offshore. During August and September (rarely in July and October) females lay 10 to 16 (commonly 10 to 12) eggs in rock crevices on shallow, sheltered reefs at depths of 1 to 5 m but occasionally down from 20 to 30 m. In captivity females lay a pair of eggs a day every 8 to 17 days. The egg cases are 13 to 17 cm long and 5 to 7 cm wide at the broad end, with broad spiral flanges that serve as anchors to keep the eggs wedge in the rocks. Females apparently favour traditional 'nest' sites which several apparently use collectively for many years. Apart from rock crevices, females may occasionally lay eggs on open sand, and eggs have been found wedged under an underwater oil pipeline and in tin cans. Eggs are oriented with their pointed ends into crevices, and females have been seen carrying eggs, suggesting that females lay their eggs, pick them up at the broad end, and insert them into appropriate crevices.

Young hatch after about 9 to 12 months and move into nursery areas in bays and estuaries. Some may retreat into deeper water during summer, but most juveniles remain in mixed groups with a 1:1 sex ratio on the nursery grounds for several years. At the beginning of sexual maturity adolescents move into deeper water and segregate into male and female groups. After several years of adolescence, apparently spent at the outer edges of the continental shelves, these groups join the adult populations.

Adult males apparently move into deeper water near the end of the breeding season, followed by the adult females in late September or October. Some adults move offshore into deeper water, but others migrate. Small numbers of adults may return to the inshore breeding reefs as early as March or April of the next year, but most do not stay inshore and few sharks are present until the onset of the next breeding season. Observed ratios of adult males and females are not significantly at variance with a 1:1 ratio.

On the east coast of Australia the Port Jackson shark shows a pattern of migration southward after breeding, with females migrating at least 5 to 6 months and moving up to 850 km south of breeding reefs before returning to the same sites the next year. Some may range as far south as Tasmania from the Sydney area in New South Wales in the annual migration cycle. It is thought that migrating adult sharks move southward in inshore coastal waters but return to their breeding reefs in deeper offshore waters.

Studies on blood proteins between Port Jackson sharks of different regions suggests that they form at least two populations, a western-southern one from western Australia to northeastern Victoria and a northeastern one from New South Wales and possibly southern Queensland. There is blood protein evidence to suggest that sharks using favoured breeding sites in 3 localities in New South Wales represent genetically distinct subpopulations, and indicates that the high site specificity shown by tagging and recapturing of sharks in this area is probably of relatively long duration.

Data from captives suggests that juveniles grow at about 5 to 6 cm per year and adults between 2 and 4 cm per year. Approximate estimates of age at maturity from captive growth data are 8 to 10 years for males and 11 to 14 years for females. So far, data is unavailable on growth rates in the wild from tagging and remeasuring of tagged individuals or from calibration and examination of fin spine or vertebral rings.

The Port Jackson shark feeds primarily on benthic invertebrates, with echinoderms the most important prey items. Prey items include sea urchins, starfishes, polychaetes, large gastropods, prawns, crabs, barnacles, and small fishes. Occasionally, garbage such as bits of mammalian fur, potato and orange peels are taken in by these sharks, although they are hardly gourmands for such items like tiger sharks (Galeocerdo). Juveniles with their smaller, more pointed teeth apparently take more soft-bodied prey than adults. Food items in stomachs are usually broken into small pieces, indicating that the sharks actively grind their food with their powerful jaws and heavy molariform teeth. Food is apparently taken at night on the bottom, and by searching close to the substrate. Olfactory cues are thought to be important, but electrosensing may play a role in this also. Food is eaten after final contact with the mouth region. Juveniles at least are capable of digging food out of the sand by sucking in water and sand and blowing it out of the gill covers. Respiration can occur by pumping water into the first, enlarged gill slits and out the last four, which is thought to allow the shark to crush and grind its prey at leisure without having to take in water through its mouth and risk passage of food out the gill slits.

Predators of this shark are poorly known, but it is suspected that adults are highly protected by their sedentary habits, cryptic, nocturnal behaviour, and disruptive colour patterns. Juveniles in nursery grounds are thought to be more vulnerable to predation by other sharks and larger benthic teleosts. Adults are sometimes attacked by small predatory isopods, and eggs attacked by male Port Jackson sharks and possibly a gastropod drilling predator. As with other sharks, this has a sizeable parasite fauna, including cestodes, trematods, nematodes, isopod larvae, copepods, fish lice, and leeches.

This shark is considered harmless to people, though presumably it can deliver a painful nip when provoked as in H. francisci.

Size : Maximum total length reported 165 cm, but apparently rare above 137 cm. Males are adolescent between 50 and 80 cm and mature between 70 and 80 cm to reach at least 105 cm; females are adolescent between 65 and about 84 cm and mature between 80 and 95 cm to reach at least 123 cm; adult females average about 25 cm longer than adult males. Size at hatching 23 to 24 cm.

Interest to Fisheries : Apparently minimal; taken by bottom trawls, shrimp nets, beach seines, bottom longlines and by rod and reel, but probably little utilized.

Literature : Whitley (1940); Fowler (1941); Smith (1942); McLaughlin & O'Gower (1970, 1971), Taylor (1972); Reif (1973); O'Gower & Nash (1978).

Remarks : Reif (1973) noted that the holotype of *Heterodontus bonae-spei*, supposedly from South Africa, is most probably a specimen of *H. portusjacksoni* with an erroneous locality label.

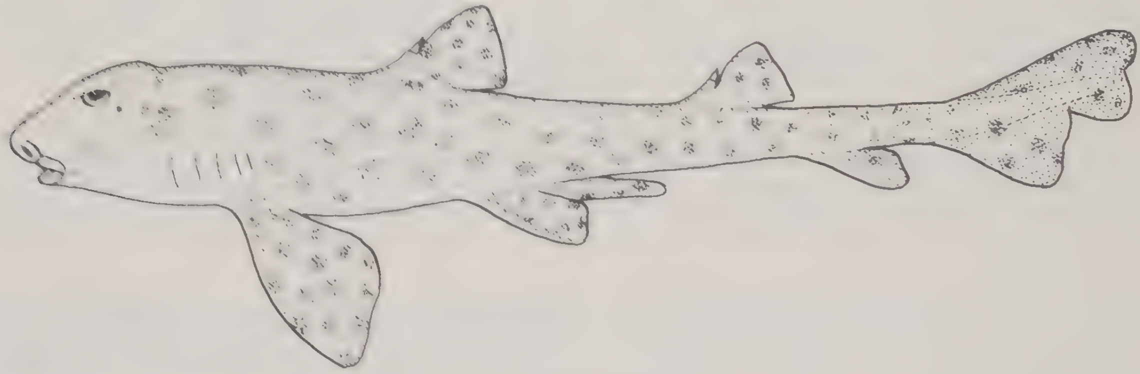
Heterodontus quoyi (Freminville, 1840)

HET Het 7

Cestracion quoyi Freminville, 1840, *Mag.Zool.*, ser. 2(2):1-3, pl. 3. Holotype: Muséum National d'Histoire Naturelle, Paris, MNHN 3445, adult male about 475 mm. Type Locality: Galapagos Islands.

Synonymy : *Cestracion pantherinus* Valenciennes, 1846 (1855); *Gyropleurodus peruanus* Evermann & Radcliffe, 1917.

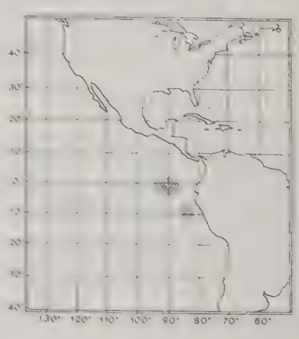
FAO Names : En - Galapagos bullhead shark; Fr - Requin dormeur bouledogue; Sp - Dormilón de Galápagos.



Field Marks : Dorsal fins with spines, anal fin present, first dorsal origin over pectoral inner margins, colour pattern of large dark spots.

Diagnostic Features : Supraorbital ridges low, not abruptly ending behind eyes; molariform teeth in rear of mouth not greatly expanded and rounded, with strong medial ridges. First dorsal origin behind pectoral bases, over pectoral inner margins; apex of anal fin reaches or falls well short of lower caudal origin; anal base less than 2 times in space between anal base and lower caudal origin. Colour light brown or grey with large black spots greater than 1/2 eye diameter in width, no light transverse band between supraorbital ridges on interorbital space. Identification of egg cases uncertain, but possibly like those of *H. francisci*, with paired, simple flat, spiral, diagonal flanges, without tendrils and with 5 turns visible on sides.

Geographical Distribution : Eastern Pacific from the coasts and offshore islands of Peru and the Galapagos Islands.



Habitat and Biology : A little-known but apparently common tropical and warm-temperate bullhead shark of inshore continental and insular waters, at moderate depths on the bottom. Feeds on crabs.

Size : Maximum total length 59 cm; an adult male was 48 cm, and an apparently newly hatched male 17 cm.

Interest to Fisheries : Not a commercial species (Norma Chirichigno, pers. comm.).

Literature : Beebe & Tee-Van (1941); McLaughlin & O'Gower (1971), Taylor (1972); Chirichigno (1980).

Remarks : Norma Chirichigno (1980, pers.comm.) suggested that there may be more than one species included under *H. quoyi*. *Quoyi*-like *Heterodontus* from Peru, with the first dorsal origin slightly behind the pectoral bases, includes two forms, one with concave posterior dorsal fin margins, a long space about twice the anal base length between the anal base and lower caudal origin, and an anal fin that falls well ahead of the lower caudal origin when laid back; and a second form with convex posterior dorsal fin margins, a short space much less than twice the anal base length between the anal base and lower caudal origin, and an anal fin that reaches the lower caudal origin when laid back. If distinct species, the first type is apparently the true H. quoyi, while the second could be distinguished as H. peruanus. I hesitate to separate these two forms with the small amount of material I have examined, however.

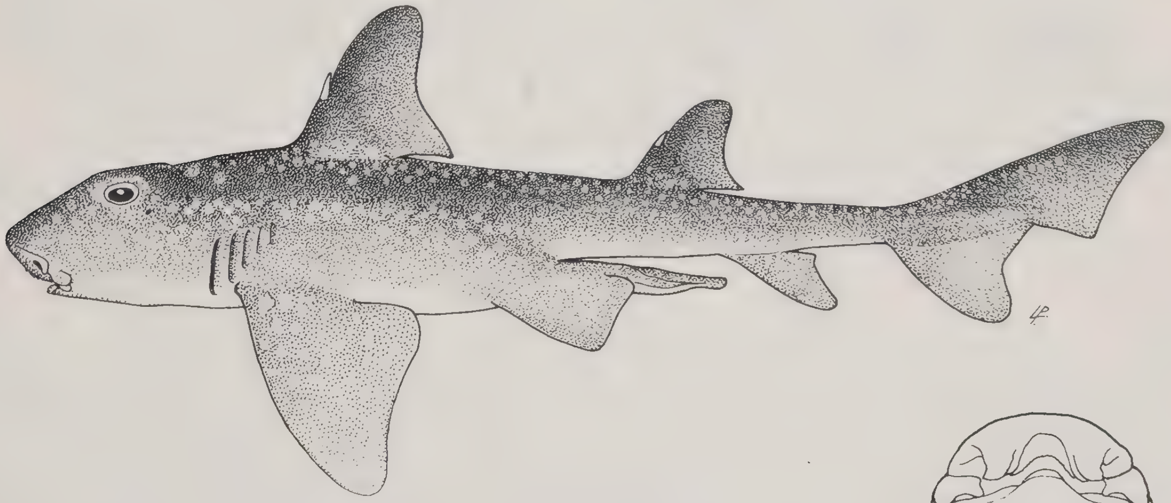
Heterodontus ramalheira (Smith, 1949)

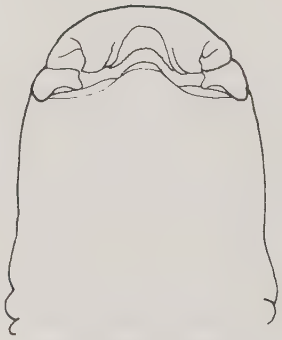
HET Het 1

Gyropleurodus ramalheira Smith, 1949a, Ann.Mag.Nat.Hist.(Ser. 12), 2:367, fig. 1. Holotype: Natural History Museum, Maputo, Mozambique, 585 mm female. Type Locality: Imhambane, Mozambique.

Synonymy : None.

FAO Names : En - Whitespotted bullhead shark; Fr - Requin dormeur chabot; Sp - Dormilón boquigrande.





underside of head

Field Marks : Dorsal fins with spines, anal fin present, colour pattern of white spots on dark background.

Diagnostic Features : Supraorbital ridges moderately high, ending abruptly behind eyes; molariform teeth in rear of mouth not greatly expanded and rounded, with a strong medial ridge. First dorsal origin over pectoral bases; apex of anal fin falling slightly ahead of lower caudal origin when laid back; anal base length slightly less than twice in space between anal insertion and lower caudal origin. Colour dark reddish brown with numerous small white spots. Egg cases unknown.

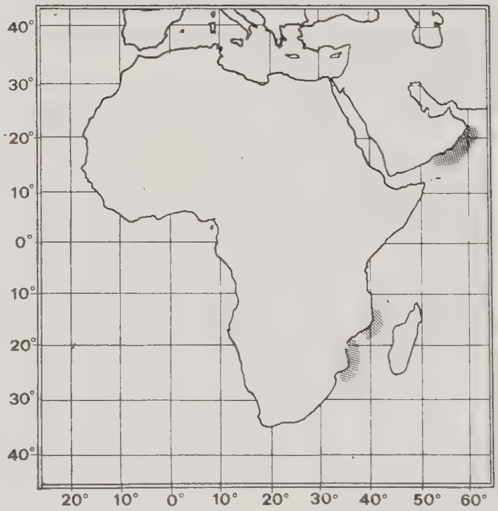
Geographical Distribution : Western Indian Ocean: Southern Mozambique, eastern shore of the Arabian Peninsula.

Habitat and Biology : A rare and little-known benthic shark of the outer continental shelf and uppermost slope of East Africa and the eastern Arabian Peninsula, unusual for the family in being a deepwater species found at 108 to 275 m. Presumably oviparous, but egg cases have not been reported to date. Crabs have been found in the stomachs of two individuals.

Size : Maximum total length 83 cm for adult females, males to at least 64 cm.

Interest to Fisheries : None, occasionally caught by commercial bottom trawlers.

Literature : Smith (1949); Pinchuk (1969); Taylor (1972); Bass, d'Aubrey & Kistnasamy (1975c).



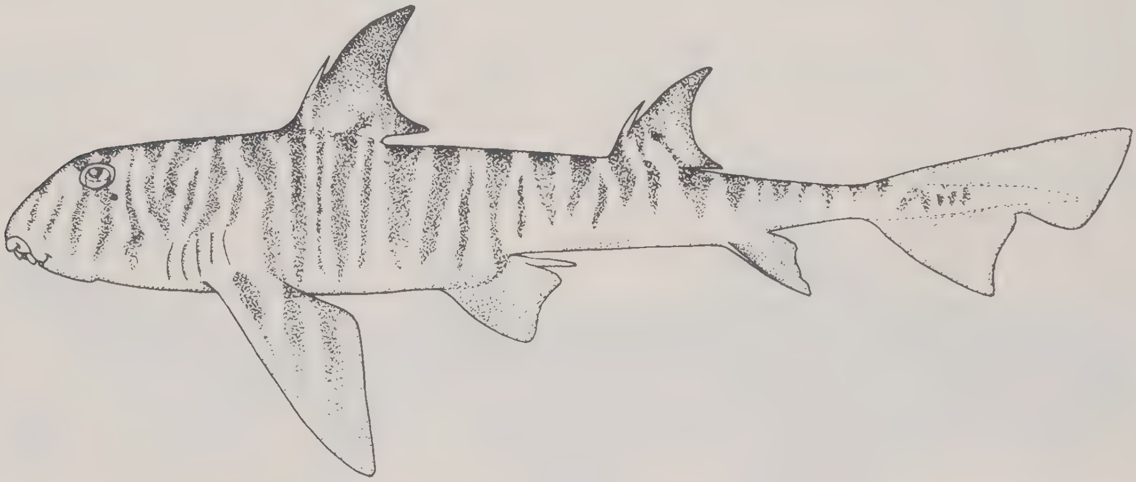
Heterodontus zebra (Gray, 1831)

HET Het 8

Centracion zebra Gray, 1831, Zool.Misc., 5. Holotype: British Museum (Natural History) ?, female about 47 cm. Type Locality: Swatow, China.

Synonymy : ? Cestracion philippi var. japonicus Dumeril, 1865 (in part?); Cestracion amboinensis Regan, 1906.

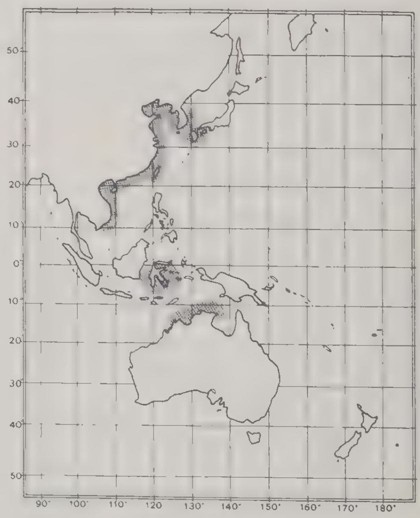
FAO Names : En - Zebra bullhead shark; Fr - Requin dormeur zèbre; Sp - Dormilón acebrado.



Field Marks : Dorsal fins with spines, anal fin present, striking colour pattern of narrow dark vertical stripes on light background.

Diagnostic Features : Supraorbital ridges low, not abruptly ending behind eyes; molariform teeth in rear of mouth not greatly expanded and rounded, with a strong medial ridge. First dorsal origin over pectoral bases; apex of anal fin falling well ahead of lower caudal origin when laid back; anal base length 2 or more times in space between anal insertion and lower caudal origin. Colour: pattern of 12 narrow vertical brown or black stripes on body, on light brown to white background, no spots or harness markings. Egg cases apparently with simple flat paired spiral flanges, nearly transverse to case axis and with only a single turn visible on sides, case apex without tendrils but with short ones on opposite end.

Geographical Distribution : Western Pacific: Japan, the Koreas, China, Viet Nam, Indonesia (Sulawesi, Ambon), Australia.



Habitat and Biology : A common but little-known bottom shark, found at moderate depths on the continental and insular shelves of the western Pacific at moderate depths down to at least 50 m. Oviparous, details of spawning not recorded. Probably eats bottom invertebrates like other members of the family.

Size : Maximum total length about 122 cm, males mature at 84 cm.

Interest to Fisheries : Probably minimal.

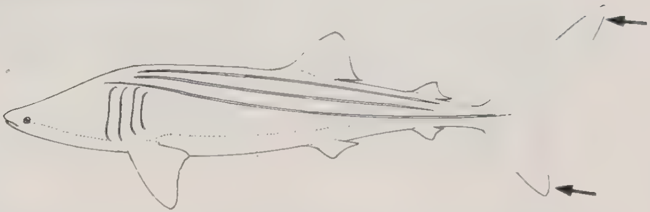
Literature : Fowler (1941); Smith (1942); Taylor (1972).

7. ORDER ORECTOLOBIFORMES - CARPET SHARKS

Order Orectolobiformes Compagno, 1973c, J.Linn.Soc.(Zool.), 53, suppl. 1.

Key to Families :

1a. Mouth huge and nearly terminal. External gill slits very large, internal gill slits inside mouth cavity with filter screens. Caudal peduncle with strong lateral keels. Caudal fin with a strong ventral lobe, but without a strong terminal lobe and subterminal notch (Fig. 1) - Whale sharks .... **Family Rhiniodontidae**



Rhiniodon Fig. 1

1b. Mouth smaller and subterminal. External gill slits small, internal gill slits without filter screens. Caudal peduncle without strong lateral keels. Caudal fin with a weak ventral lobe or none, but with a strong terminal lobe and subterminal notch (Fig. 2)

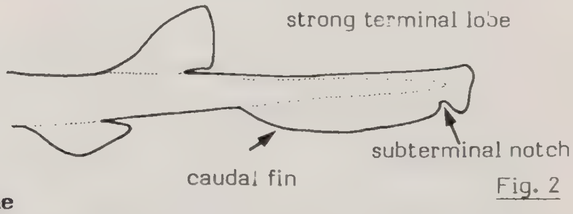
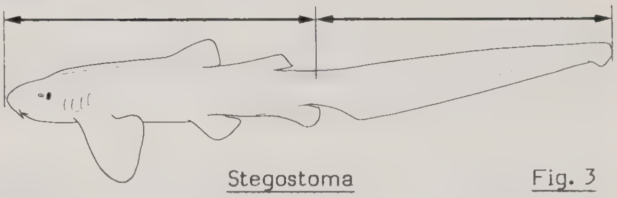


Fig. 2

2a. Caudal fin about as long as rest of shark (Fig. 3) - Zebra shark .... **Family Stegostomatidae**

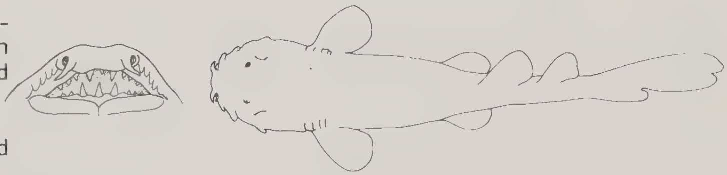
2b. Caudal fin much shorter than rest of shark



Stegostoma Fig. 3

3a. Head and body greatly flattened, head with skin flaps on sides. Two rows of large, fanglike teeth at symphysis of upper jaw and 3 in lower jaw (Fig. 4) - Wobbegongs ..**Family Orectolobidae**

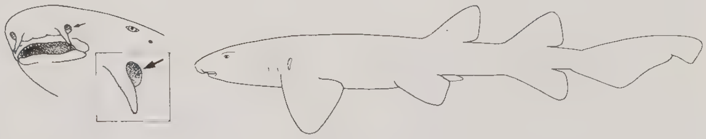
3b. Head and body cylindrical or moderately flattened, head without skin flaps. Teeth small, not enlarged and fanglike at symphysis



Orectolobus Fig. 4

4a. No lobe and groove around outer edges of nostrils (Fig. 5) - Nurse shark ..... **Family Ginglymostomatidae**

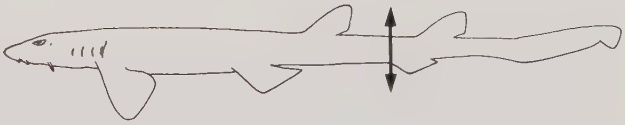
4b. A lobe and groove around outer edges of nostrils (Fig. 8)



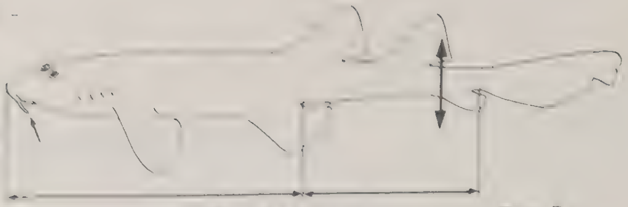
Ginglymostoma Fig. 5

5a. Spiracles minute. Origin of anal fin well in front of second dorsal origin, separated from lower caudal origin by space equal or greater than its base length (Fig. 6) - Collared carpetsharks ....**Family Parascylliidae**

5b. Spiracles large. Origin of anal fin well behind second dorsal origin, separated from lower caudal origin by space less than its base length

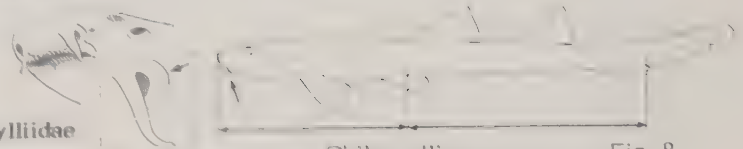


Cirrhoscyllium Fig. 6



Brachaelurus Fig. 7

6a. Nasal barbels very long. Anal fin high and angular. Distance from vent to lower caudal origin shorter than distance from snout to vent (Fig. 7) - Blind sharks .... **Family Brachaeluridae**



Chiloscyllium Fig. 8

6b. Nasal barbels short. Anal fin low, rounded and keel-like. Distance from vent to lower caudal origin longer than distance from snout to vent (Fig. 8) - Longtail carpetsharks ..... **Family Hemiscylliidae**

7.1 FAMILY PARASCYLLIIDAE Gill, 1862

PARASC

Subfamily Parascylliinae Gill, 1862 (Family Scylliorhinoidae), *Ann.Lyceum Nat.Hist.N.Y.*, 7(32):408.

Synonymy : Family Cirrhoscylliidae Applegate, 1974.

FAO Names : En - Collared carpetsharks; Fr - Requins carpettes; Sp - Alfonbreras.

Field Marks : Small sharks, superficially similar to members of the family Scyliorhinidae in their slender form, catlike eyes with subocular pockets, first dorsal origin behind pelvic bases, and fin proportions, but differing in having their mouths entirely in front of eyes and in having narrow nasoral grooves, circumnarial grooves and folds around the nostrils, and medial barbels not derived from the anterior nasal flaps. Their mouth and nostril structures, two spineless dorsal fins and an anal fin, anal fin origin well ahead of second dorsal origin, and minute spiracles distinguish them from other sharks.

Diagnostic Features : Body cylindrical or slightly depressed, without ridges on sides. Head narrow and slightly flattened, without lateral flaps of skin, snout broadly rounded to slightly pointed; eyes dorsolaterally situated on head, with subocular pockets; spiracles minute, much smaller than eyes and not below them; gill slits small, fifth overlapping fourth; internal gill slits without filter screens; nostrils with short, pointed barbels and distinct circumnarial folds and grooves around outer edges of incurrent apertures; mouth small, subterminal on head, and arched, without a symphyseal groove on chin; teeth no strongly differentiated in jaws, with a medial cusp, lateral cusplets and relatively strong labial root lobes; tooth rows 27 to 54/25 to 49. Dorsal fins equal-sized, first dorsal with origin and insertion well behind the pelvic bases; pectoral fins small, broad and rounded, as large as pelvic fins or slightly larger, with fin radials not expanded into fin web; pelvic fins about as large as dorsals but slightly greater than anal fin; anal fin somewhat smaller than second dorsal, with its origin well ahead of second dorsal origin; anal fin with broad base and angular apex, separated by a space greater than its base length from lower caudal origin; caudal fin with its upper lobe not elevated above the body axis, less than a quarter as long as the entire shark, with a strong terminal lobe and subterminal notch but no ventral lobe. Caudal peduncle without lateral keels or precaudal pits. Supraorbital crests absent from cranium. Valvular intestine of spirale type. Colour pattern of dark and light spots and saddle markings, in some species also a dark collar around gills.

Habitat, Distribution and Biology : These are little-known, rare to common, harmless bottom sharks of often deepish temperate and tropical, continental waters of the western Pacific, occurring from close inshore to at least 183 m offshore. One genus (*Parascyllium*) is confined to Australian waters while the second (*Cirrhoscyllium*) occurs in the China Sea north to Japan and Taiwan Island. They are found on muddy, sandy or rocky bottom, and apparently can change colour somewhat to match the bottom type. All species are small, less than a metre long when mature. At least some of the species are ovoviviparous, depositing eggs in elongated, flattened egg cases on the bottom. Food is little known, but probably include small fishes, crustaceans, and other bottom invertebrates.

Interest to Fisheries : Several species are taken in bottom trawls, but utilization is probably minimal.

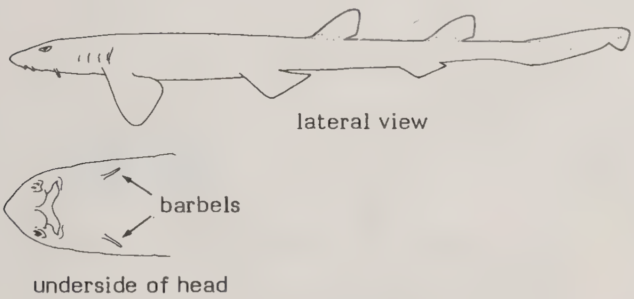
Remarks : Applegate (1974) proposed a separate family for the genus *Cirrhoscyllium*, but external and anatomical studies by the writer strongly suggest that this genus is closely related to *Parascyllium* although readily distinguishable from it, and that both genera are referable to a single family. These sharks are remote from other orectoloboids and are distinguishable from them by their teeth, with strong labial root lobes (variably reduced in other orectoloboids) and low basal ledges (expanded in most other orectoloboids); well-arched mouths; anal fin origin well anterior to second dorsal origin; cranium greatly reduced, with no supraorbital crests, suborbital shelves narrow and reduced, anterior fontanelle extending rearward to between endolymphatic foramina and nearly reaching foramen magnum, huge fenestrae on dorsal and posterolateral surfaces of the nasal capsules; an extraordinary suite of highly specialized head muscles that are unique to these sharks, including the anterodorsal palbebral depressor that closes the upper eyelids, the dorsal rostronuchal and ethmonuchal muscles between nape and snout, and the ethmomandibular muscle between jaws and snout; vertebral central with simple wedge-shaped intermedialia but no radii; and spiral intestinal valves (a ring valve, or quasi-ring valve in other orectoloboids). Clasper morphology is unknown for Cirrhoscyllium, but Parascyllium has highly specialized claspers with a unique, medial, fingerlike, spurbearing lobe supported by the dorsal terminal cartilage as well as a row of unique clasper hooks on the ventral terminal cartilage.

Applegate (1974) placed the two parascylliid genera in a separate suborder of the Orectolobiformes, emphasizing their distinctiveness; in cladistic terms, the Parascylliidae is the quasi-primitive sister group of all other orectoloboids.

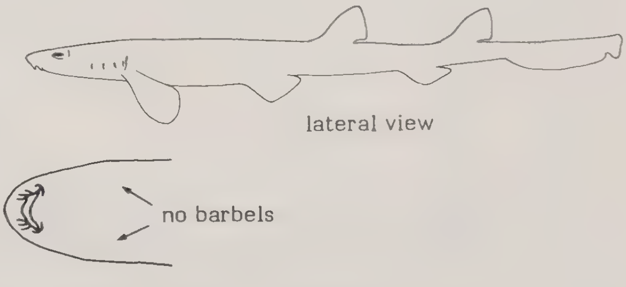
Key to Genera :

1a. A pair of barbels on throat (Fig. 1) ...... **Cirrhoscyllium**

1b. No barbels on throat (Fig. 2) .... **Parascyllium**



Cirrhoscyllium Fig. 1



Parascyllium Fig. 2

Cirrhoscyllium Smith & Radcliffe, 1913

PARASC Cirr

Genus : Cirrhoscyllium Smith & Radcliffe, 1913 (not Cirriscyllium Ogilby, 1908 = Genus Brachaelurus Ogilby, 1907), Proc.U.S.Nat.Mus., 45(1997):568.

Type Species : Cirrhoscyllium expolitum Smith & Radcliffe, 1913, by original designation.

Synonymy : Genus Zev Whitley, 1927 (replacement for Cirrhoscyllium thought by Whitley to be preoccupied by Cirriscyllium).

Diagnostic Features : Snout relatively long, narrow, and pointed, head broad and flattened, back somewhat humped over gills and pectoral bases. A pair of barbels present on throat, unique to this genus and found in no other sharks. Eyes horizontally oval. Tooth counts 27 to 29/25 to 26 in adults. Pectoral fins relatively thin and rather large, their anterior margins nearly equal to head length and distance between pectoral and pelvic bases. Colour pattern of dark saddles present, but no small spots or collar markings around gills.

Remarks : Data for the three species of Cirrhoscyllium are from Smith & Radcliffe (1913), Kamohara (1943), and Teng (1959). It is not certain at present whether the characters used to distinguish the three species are valid, and if so, if the three species are synonyms. Pending further studies on the genus these species are provisionally recognized

Key to Species :

1a. First dorsal origin about equidistant between snout tip and subterminal notch of caudal fin. Six dark saddles on back and tail .... **C. formosanum**

1b. First dorsal fin closer to snout tip than subterminal notch. Nine or ten dark saddles on back and tail

  2a. First dorsal origin well behind pelvic free rear tips. Anal insertion below second dorsal origin, free rear tip reaches first fourth of second dorsal base, anal base shorter than distance from anal insertion to lower caudal origin .... **C. japonicum**

  2b. First dorsal origin over pelvic free rear tips. Anal insertion below midbase of second dorsal, free rear tip reaches second dorsal insertion, base about equal to distance from anal insertion to lower caudal origin .... **C. expolitum**

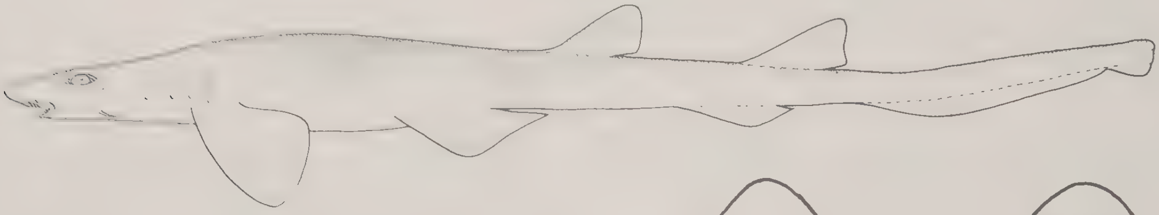
Cirrhoscyllium expolitum Smith & Radcliffe, 1913

PARASC Cirr 1

Cirrhoscyllim expolitum Smith & Radcliffe, 1913, Proc.U.S.Nat.Mus., 45(1997):568, pl. 45. Holotype: US National Museum of Natural History, USNM-74603, 335 mm female. .Type Locality: China Sea between northern Luzon, Philippines, and China, 21°33'N, 118°13'E, 183 m.

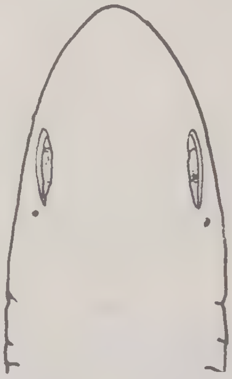
Synonymy : None.

FAO Names : En - Barbelthroat carpetshark; Fr - Requin carpette à moustache ; Sp - Alfonbrera barbuda.

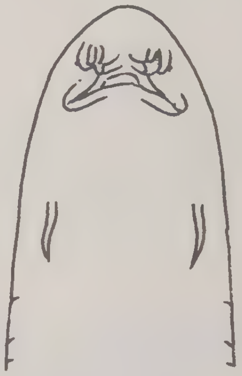


Field Marks : Barbels on throat, nasoral grooves, mouth in front of eyes, ten saddle marks on dorsal surface, first dorsal origin over pelvic free rear tips, anal insertion below second dorsal midbase.

Diagnostic Features : First dorsal origin over pelvic free rear tips, closer to snout tip than subterminal notch; anal insertion below midbase of second dorsal, free rear tip reaches second dorsal insertion, anal base about equal to distance from anal insertion to lower caudal origin. Colour: trunk, tail, and caudal fin with about ten dark saddles.



dorsal view of head



underside of head

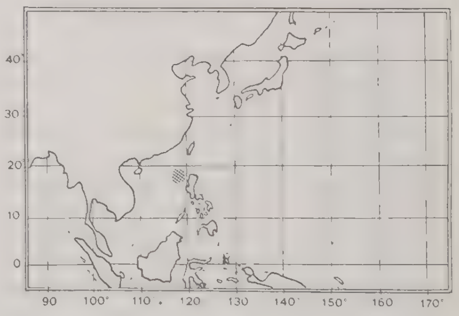
Geographical Distribution : Western North Pacific: China Sea between Luzon, Philippines, and China.

Habitat and Biology : A little-known tropical bottom shark of the continental shelf of the China Sea, offshore on or near the bottom at 183 m depth. Probably oviparous, judging from large nidamental gland, but eggs are not known. Food habits unknown.

Size : The adult female holotype and only known specimen is 33.5 cm long.

Interest to Fisheries : Unknown.

Literature : Smith (1913); Teng (1959).



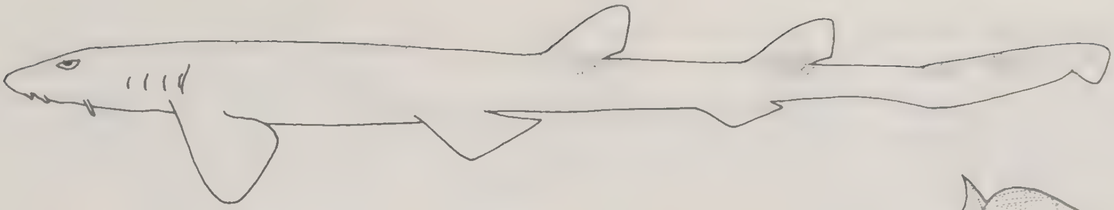
Cirrhoscyllium formosanum Teng, 1959

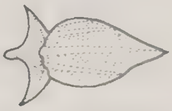
PARASC Cirr 2

Cirrhoscyllium formosanum Teng, 1959a, Rep.Lab.Fish.Biol.Taiwan Fish.Res.Inst., Keelung, (7):1, pl. 1. Holotype: Taiwan Fisheries Research Institute Fish Specimen 3574, 367 mm female. Type Locality: Taiwan Island off Kao-Hsiung, 110 m.

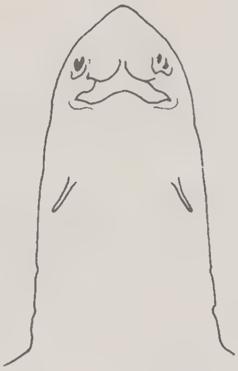
Synonymy : None.

FAO Names : En - Taiwan saddled carpetshark; Fr - Requin carpette chin; Sp - Alfonbrera de Taiwan.

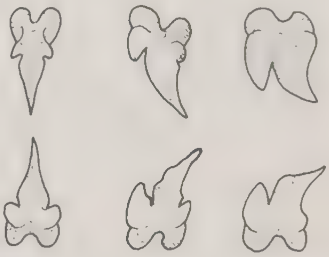




dermal denticle



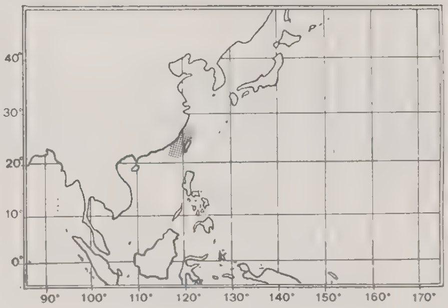
underside of head



upper and
lower teeth

Field Marks : Barbels on throat, nasoral grooves, mouth in front of eyes, six saddle marks on dorsal surface, first dorsal origin over pelvic free rear tips, anal insertion below first third of second dorsal base.

Diagnostic Features : First dorsal origin over pelvic free rear tips, halfway between snout tip and subterminal notch; anal insertion below first third of second dorsal, free rear tip ends well in front of second dorsal insertion, at about second dorsal midbase; anal base slightly greater than distance from anal insertion to lower caudal origin. Colour: trunk, tail, and caudal fin with about six dark saddles.



Geographical Distribution : Western North Pacific: Taiwan Island.

Habitat and Biology : A little-known small, tropical or subtropical shark of the insular shelf of Taiwan Island, at depth of about 110 m.

Size : Maximum total length 39 cm; reported specimens (males and females) 35 to 39 cm, possibly adult if of similar size to C. expolitum.

Interest to Fisheries : Unknown, taken by bottom longlines off Taiwan Island.

Literature : Teng (1959)

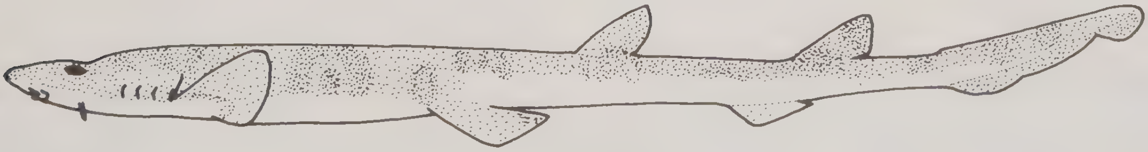
Cirrhoscyllium japonicum Kamohara, 1943

PARASC Cirr 3

Cirrhoscyllium japonicum Kamohara, 1943, Bull.Biogeogr.Soc.Jap., 13:126, fig. 1. Holotype: 485 mm female. Type Locality: Mimase, Japan.

Synonymy : None.

FAO Names : En - Saddle carpetshark; Fr - Requin carpette chat; Sp - Alfombrera japonesa.



Field Marks : Barbels on throat, nasoral grooves, mouth in front of eyes, nine saddle marks on dorsal surface, first dorsal origin well behind pelvic free rear tips, anal insertion below first fourth of second dorsal base.

Diagnostic Features : First dorsal origin well behind pelvic free rear tips, nearer subterminal notch than snout tip; anal insertion below first fourth of second dorsal, free rear tip ends well anterior to second dorsal insertion, at first third of dorsal base; anal base much less than distance from anal insertion to lower caudal origin. Colour: trunk, tail, and caudal fin with about nine dark saddles.

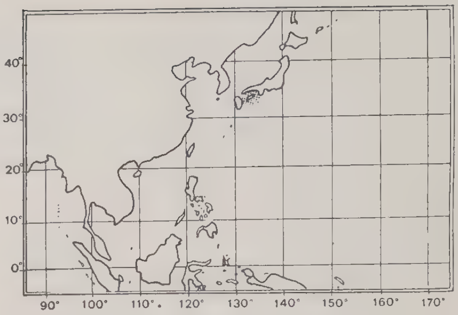
Geographical Distribution : Western North Pacific: Japan (Shikoku).

Habitat and Biology : A poorly known subtropical or warm-temperate shark, from Mimase, Shikoku, Japan.

Size : Maximum total length 49 cm (female, possibly adult).

Interest to Fisheries : Unknown.

Literature : Kamohara (1943); Teng (1959).



Parascyllium Gill, 1862

PARASC Parasc

Genus : Parascyllium Gill, 1862, Ann.Lyceum Nat.Hist.N.Y., 7(32):408-12.

Type Species : Hemiscyllium variolatum Dumeril, 1853 by original designation.

Synonymy : Subgenus Neoparascyllium Whitley, 1939 (Genus Parascyllium Gill, 1862).

Diagnostic Features : Snout relatively short, thick, and broadly rounded, head narrow and cylindrical, back not humped over gills and pectoral bases; no barbels on throat; eyes slitlike; tooth counts 37 to 54/33 to 49 in adults. Pectoral fins thick, muscular, and rather small, their anterior margins much less than head length and distance between pectoral and pelvic bases. Colour pattern of light or dark spots present, sometimes with dark saddles, black blotches, and collar markings around gills.

Remarks : The present arrangement of the species of Parascyllium follows Whitley (1940) in most details. However, after examining specimens of Parascyllium multimaculatum I do not recognize the subgenus Neoparascyllium for this species as it differs little from P. ferrugineum and P. collare except in colour pattern. Its differences are best ranked as interspecific rather than subgeneric.

Key to Species :

1a. Gill region with a prominent dark collar marking dotted with dense white spots, body with brown blotches and small white spots, fins with very prominent large black blotches .... **P. variolatum**

1b. Gill region with an indistinct to prominent dusky collar marking with or without a few brown spots but lacking white spots, body with small to moderately large brown spots but no blotches, fins with small brown spots but no black blotches

  2a. Gill region with a prominent dusky collar, dark spots absent from pectoral fins .... **P. collare**

  2b. Gill region with collar marking obscure, dark spots present on pectoral fins

    3a. Dark spots sparse on fins and body .... **P. ferrugineum**

    3b. Dark spots densely covering upper surface of fins and body .... **P. multimaculatum**

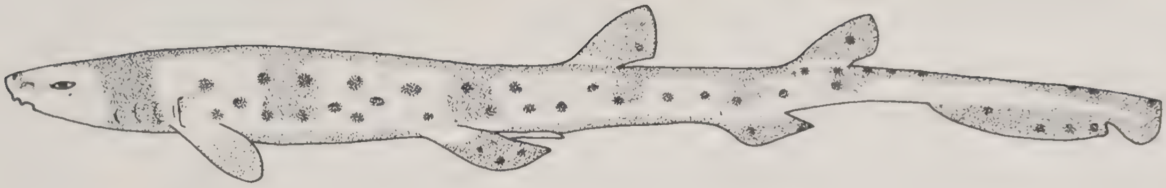
Parascyllium collare Ramsay & Ogilby, 1888

PARASC Parasc 1

Parascyllium collare Ramsay & Ogilby, 1888, Proc.Linn.Soc.New South Wales, ser. 2, 3:1310. Holotype: Australian Museum, Sydney. Type Locality: Off Port Jackson, New South Wales, Australia.

Synonymy : None.

FAO Names : En - Collared carpetshark; Fr - Requin carpette à collarette; Sp - Alfombrera collareja.



Field Marks : Prominent dark, unspotted collar around the gills, dusky saddles and sparse, large dark spots on body, tail and fins, nasal barbels, nasoral and circumnarial grooves present, mouth in front of eyes, two equal-sized, spineless dorsal fins and an anal fin, the first dorsal origin behind the pelvic bases, the anal fin origin well in front of the second dorsal origin.

Diagnostic Features : Colour light yellowish to reddish brown with six to eight dusky saddles on trunk, tail and caudal fin, a prominent dark, unspotted collar marking around gill region, sparse, scattered, large dark brown spots on sides and fins, except for pectoral fins, no more than two or three irregular rows of spots on sides.

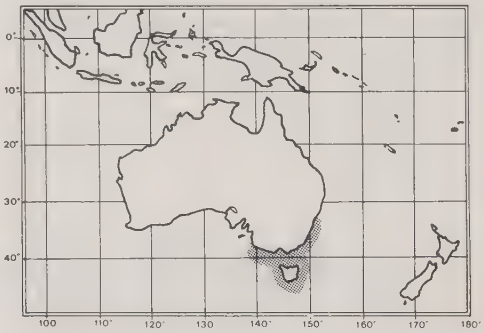
Geographical Distribution : Western South Pacific: Australia (Victoria, Tasmania, New South Wales).

Habitat and Biology : A common but little-known temperate shark of the Australian continental shelf, common on or near rock reefs and on firm bottom at depths from 18 to 156 m, commonest at about 55 to 128 m. Oviparous.

Size : Maximum total length about 87 cm, adult males from 80 to 85 cm long; adult females from 85 to 87 cm.

Interest to Fisheries : Probably none or limited, although commonly taken by bottom trawlers and sometimes with line gear.

Literature : Whitley (1940); Fowler (1941); Stead (1963).



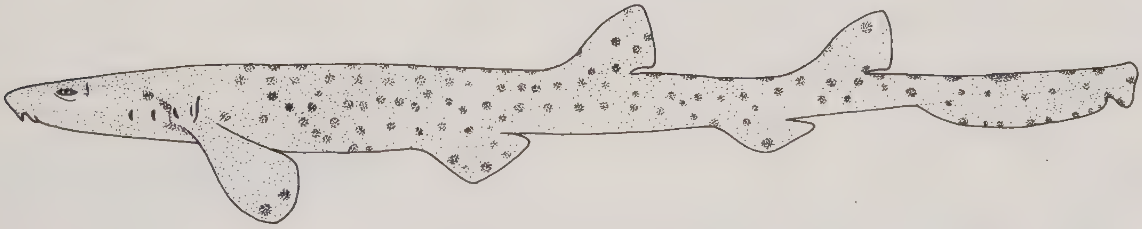
Parascyllium ferrugineum McCulloch, 1911

PARASC Parasc 2

Parascyllium ferrugineum McCulloch, 1911, Zool.Resul.Fish.Exp.Endeavour, 1:7, fig. 2, pl. 2, fig. 2. Holotype: Australian Museum, Sydney. Type Locality: Off Port Phillip Heads, Victoria, Australia.

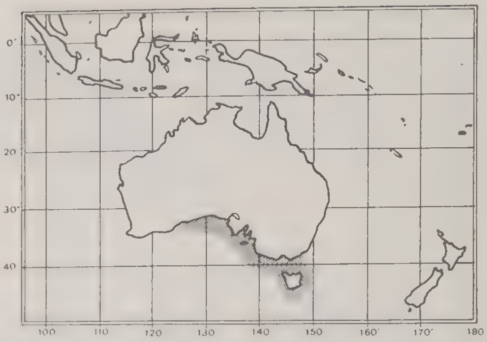
Synonymy : None.

FAO Names : En - Rusty carpetshark; Fr - Requin carpette roux; Sp - Alfombrera mohosa.



Field Marks : Inconspicuous dusky collar around the gills, with three or four dark spots, dusky saddles on back and tail, and sparse, large dark spots on body, tail and fins, nasal barbels, nasoral and circumnarial grooves present, mouth in front of eyes, two equal-sized, spineless dorsal fins and an anal fin, the first dorsal origin behind the pelvic bases, the anal fin origin well in front of the second dorsal origin.

Diagnostic Features : Colour grey brown with six dusky saddles on trunk, tail and caudal fin; an indistinct dark, unspotted collar marking around gill region, with three or four dark spots; sparse, scattered, large dark brown spots on sides and fins, no more than three or four irregular rows of spots on sides.



Geographical Distribution : Western South Pacific: Confined to Australian waters (Victoria, South Australia, and Tasmania).

Habitat and Biology : A common, little-known temperate-water shark of the Australian continental shelf, on or near bottom at depths of 37 to 55 m. Probably oviparous.

Size : Maximum total length 75 cm, male adult at 75 cm, female adolescent at 74 cm; probably hatchling about 17 cm.

Interest to Fisheries : Probably none at present. Captured in bottom trawls.

Literature : Whitley (1940); Fowler (1941); Stead (1963).

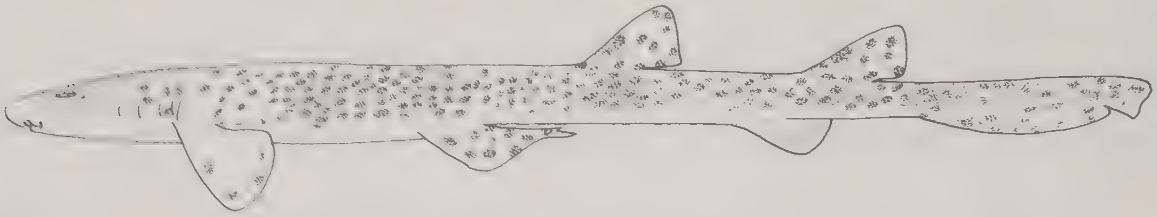
Parascyllium multimaculatum Scott, 1935

PARASC Parasc 3

Parascyllium multimaculatum Scott, 1935, Pap.Proc.Roy.Soc.Tasmania, 1934:63, fig. 1. Holotype: Adult male 710 mm. Type Locality: Tamar Heads, Devon Dorset, Tasmania, Australia.

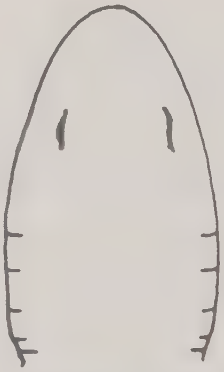
Synonymy : None.

FAO Names : En - Tasmanian carpetshark; Fr - Requin carpette tacheté; Sp - Alfombrera tasmánica.

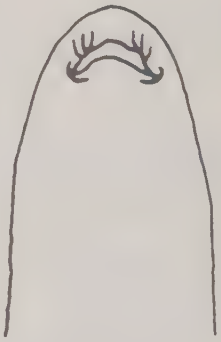


Field Marks : Inconspicuous dusky collar around the gills, with or without dark spots, dusky saddles on back and tail, and a dense pattern of small to large dark spots on body, tail and fins, nasal barbels, nasoral and circumnarial grooves present, mouth in front of eyes, two equal sized, spineless dorsal fins and an anal fin, the first dorsal origin behind the pelvic bases, the anal fin origin well in front of the second dorsal origin.

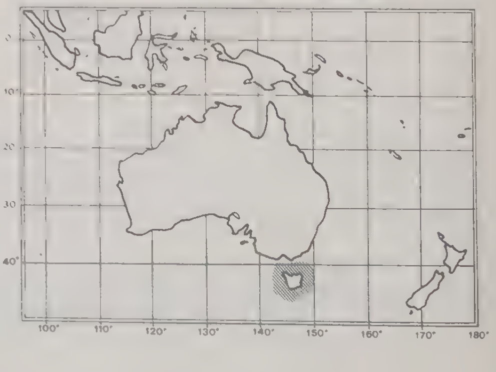
Diagnostic Features : Colour greyish with six or seven dusky saddles on trunk, tail and caudal fin; an indistinct dark, collar marking around gill region, with or without a few large dark spots; numerous small to large dark brown spots on sides and fins, five or six irregular rows of spots on sides.



dorsal view of head



underside of head



Geographical Distribution : Western South Pacific: Tasmania, Australia.

Habitat and Biology : A little known temperate-water bottom shark of the Tasmanian insular shelf, found near rocks and river mouths close inshore.

Size : Maximum total length reported 75 cm, adults males 71 to 75 cm; adolescent female 74 cm.

Interest to Fisheries : None at present.

Literature : Whitley (1940); Scott (1961).

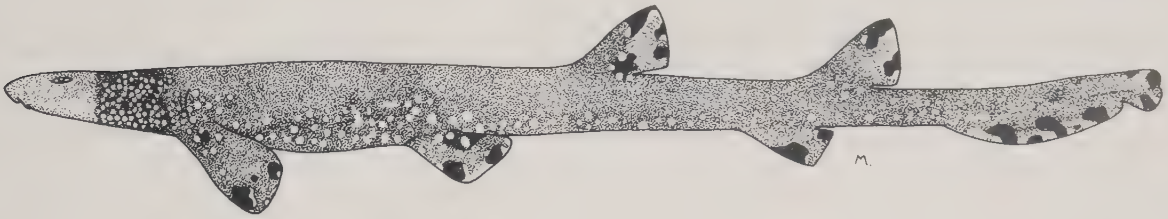
Parascyllium variolatum (Dumeril, 1853)

PARASC Parasc 4

Hemiscyllium variolatum Dumeril, 1853, Rev.Mag.Zool., ser. 2, 5:121, pl. 3, fig. 1. Holotype: Muséum National d'Histoire Naturelle, Paris, MNHN 1004, 380 mm female. Type Locality: Tasmania, Australia.

Synonymy : Parascyllium nuchalis McCoy, 1874.

FAO Names : En - Necklace carpetshark; Fr - Requin carpette à collier; Sp - Alfombrera colarina.



Field Marks : The bold, beautiful colour pattern of this shark is unmistakable: a unique, broad, dark, white-spotted collar around the gills, striking black marks on all fins, dark blotches and white spots on body; also, barbels, nasoral and circumnarial grooves, mouth in front of eyes, two equal-sized, spineless dorsal fins and an anal fin, and the first dorsal origin behind the pelvic bases.

Diagnostic Features : Body clouded with irregular dark brown blotches and sprinkled with white spots; a blackish-brown, extremely conspicuous collar marking around the gill region, densely spotted with white like a necklace of pearls; bold black spots and blotches present on all fins.

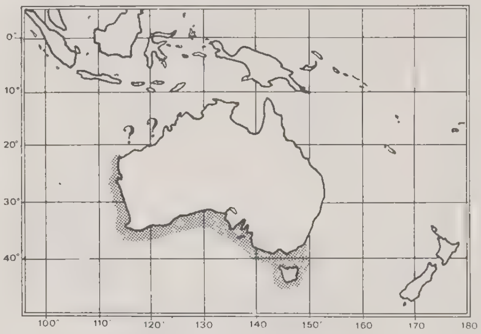
Geographical Distribution : Western South Pacific: Australia (Victoria, Tasmania, South and Western Australia).

Habitat and Biology : A little-known, temperate-water, common bottom shark of the Australian continental shelf at depths down to about 165 m. Probably oviparous.

Size : Maxiumum total length about 91 cm.

Interest to Fisheries : Probably none at present.

Literature : Whitley (1940); Fowler (1941); Stead (1963).



7.2 FAMILY BRACHAELURIDAE Applegate, 1974

BRACH

Family Brachaeluridae Applegate, 1974, J.Mar.Biol.Assoc.India, 14(1972):745.

Synonymy : None.

FAO Names : En - Blind sharks; Fr - Requins aveugles; Sp - Tiburones ciegos.

Field Marks : Small sharks with nasoral grooves, perinasal grooves, long barbels, small transverse mouths in front of eyes, dorsolateral eyes, large spiracles below eyes, no lateral skin flaps on head, two spineless dorsal fins and an anal fin, the second dorsal origin well ahead of the anal origin, and a short precaudal tail much shorter than the head and body.

Diagnostic Features : Body cylindrical or moderately depressed, without ridges on sides. Head broad and somewhat flattened, without lateral flaps of skin, snout broadly rounded; eyes dorsolaterally situated on head, with subocular pockets, spiracles very large, subequal or larger than eyes and somewhat below them; gill slits small, fifth close to fourth but not overlapping it; internal gill slits without filter screens; nostrils with long, pointed barbels and distinct circumnarial folds and grooves around outer edges of incurrent apertures; mouth small, subterminal on head, and nearly transverse, with or without a symphyseal groove on chin; teeth not strongly differentiated in jaws, with a medial cusp, lateral cusplets and weak labial root lobes; tooth rows 32/21. Dorsal fins equal-sized, first dorsal with origin over the pelvic bases and insertion well behind the pelvic rear tips; pectoral fins moderate-sized, broad and rounded, as large as pelvic fins or slightly larger, with fin radials not expanded into fin web; pelvic fins about as large as dorsals but slightly greater than anal fin; anal fin as large as or somewhat smaller than second dorsal, with its origin about opposite second dorsal midbase or insertion; anal fin with broad base and angular apex, separated by a space or narrow notch much less than base length from lower caudal origin; caudal fin with its upper lobe at a low angle above the body axis, less than a third as long as the entire shark, with a strong terminal lobe and subterminal notch but no ventral lobe. Caudal peduncle without lateral keels or precaudal pits. Supraorbital crests present on cranium, not laterally expanded. Valvular intestine of spiral-ring type. Colour pattern of dark saddles and light spots present, or colour plain.

Habitat, Distribution and Biology : These are common, small, harmless, inshore bottom sharks confined to temperate and tropical continental waters of Australia, ranging in depth from the intertidal down to 110 m. They commonly occur on rocky reefs or on coral close inshore, sometimes in water only sufficient to cover them. These sharks are small less than 1.3 m maximum length. At least one of the species is ovoviviparous. Known food items of these sharks include small fishes, crustaceans, cuttlefish and sea anemones. At least one of the species is very hardy and can live a long time out of water as well as readily in captivity. The name 'blind shark' stems not from lack of vision but from the habits of one of the two species, which closes its eyelids when removed from the water.

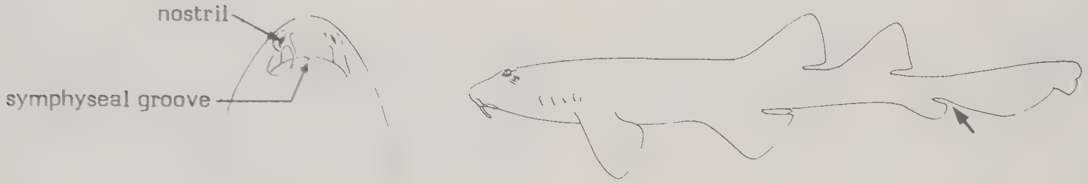
Interest to Fisheries : Limited, captured in bottom trawls. Brachaelurus is captured by sports fishermen.

Remarks : I recognize this family following Applegate's (1974) review.

Key to Genera :

1a. A median symphyseal groove present on chin (Fig. 1a). Anal fin insertion just anterior to lower caudal origin (Fig. 1b) .... **Brachaelurus**

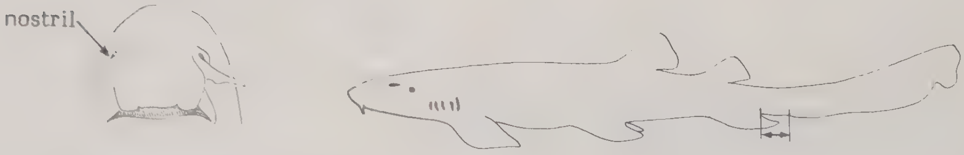
1b. No symphyseal groove on chin. Anal fin insertion separated from lower caudal origin by a space equal to anal inner margin (Fig. 2a,b) .... **Heteroscyllium**



a. underside of head

b. lateral view

Brachaelurus Fig. 1



a. underside of head

b. lateral view

Heteroscyllium Fig. 2

Brachaelurus Ogilby, 1907

BRACH Brach

Genus : *Brachaelurus* Ogilby, 1907, *J.Proc.R.Soc.Queensl.*, 1906, 20:27.

Type Species : *Chiloscyllium modestum* Günther, 1871, by original designation.

Synonymy : Genus *Cheloscyllium* Maclay, *in* Ramsay, 1880 (error for *Chiloscyllium* Müller & Henle, 1837); Genus *Cirriscyllium* Ogilby, 1908 (replacement for Genus *Brachaelurus* Ogilby, 1907).

Diagnostic Features : A median symphyseal groove present on chin. Nostrils nearly terminal on snout. Spiracles large and close to eyes. First dorsal fin about as large as second dorsal. Anal origin about under insertion of second dorsal fin, anal insertion just anterior to lower caudal origin. Caudal fin short, length of its dorsal margin usually less than distance from snout tip to pectoral fin insertion.

Remarks : See Bigelow & Schroeder (1948: 180, ftn. 5) for a discussion of the nomenclatural history of this genus and *Heteroscyllium*.

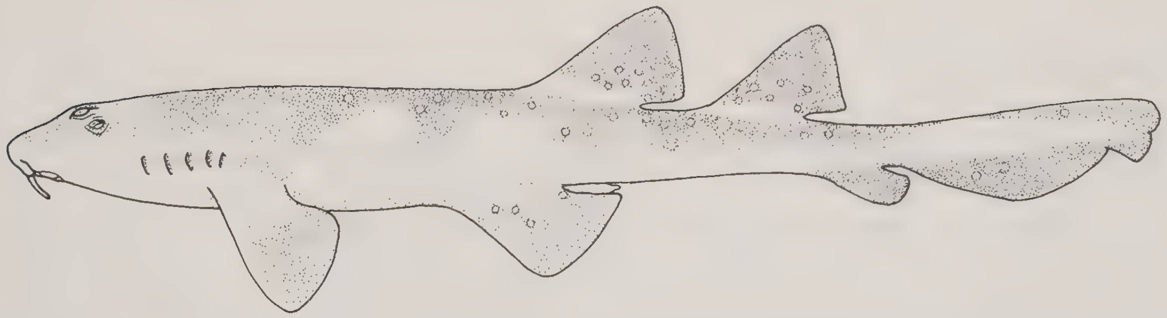
Brachaelurus waddi (Bloch & Schneider, 1801)

BRACH Brach 1

Squalus waddi Bloch & Schneider, 1801, *Syt.Ichth.*, 130. Holotype: Unknown. Type Locality: Australia.

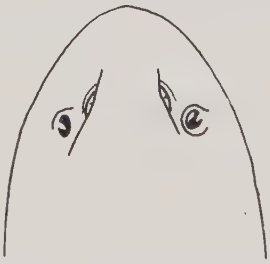
Synonymy : *Chiloscyllium modestum* Günther, 1871; *Chiloscyllium furvum* Macleay, 1881; *Chiloscyllium fuscum* Parker & Haswell, 1897.

FAO Names : En - Blind shark; Fr - Requin aveugle des roches; Sp - Tiburón ciego de roca.

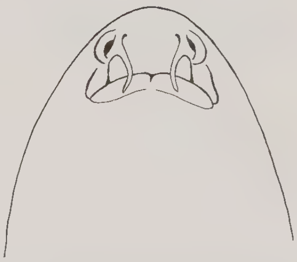


Field Marks : A small stout shark with long barbels, nasoral grooves and perinasal grooves, very large spiracles, a short mouth ahead of the eyes, a median symphyseal groove on the chin, no dermal lobes on sides of head, two equal-sized spineless dorsal fins and an anal fin, the first dorsal origin over the pelvic bases, a short precaudal tail and short caudal fin, and colour blackish to light brown with or without darker saddles, light yellowish on underside, sometimes with many small white spots.

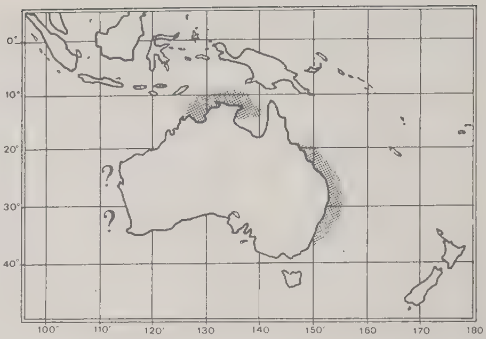
Diagnostic Features : See genus.



dorsal view of head



underside of head



Geographical Distribution : Western South Pacific: Australia (Northern Territory, southern Queensland, New South Wales, possibly Western Australia).

Habitat and Biology : A common, harmless, inshore bottom shark of temperate Australian waters, often close inshore in tidepools that are barely deep enough to cover it and at the surf line but occasionally down to about 73 m and exceptionally to 110 m. It favour rocky shoreline areas and coral reefs.

Development ovoviviparous, with 7 or 8 young in a litter. Said to breed in summer (November in the Sydney area).

Feeds on small reef invertebrates, including crabs, shrimp, cuttlefish and sea anemones, and small fishes; a coralline alga was found in the stomach of one shark.

A hardy shark that thrives in aquaria, and apparently can live a long time out of water. Termed 'blind shark' by fishermen because it retracts its eyeballs, which causes its thick eyelids to close, when removed from the water.

Size : Maximum total length exceptionally 90 to 122 cm; an adult male was 62 cm long and an adult female, 66 cm; size at birth 15 to 18 cm.

Interest to Fisheries : Minimal, taken offshore in bottom trawls but utilization not recorded. Commonly caught by sports fishermen with rod and reel from shore in rocky areas, particularly around Sydney.

Literature : Waite (1901); Whitley (1940); Fowler (1941); Stead (1963).

Remarks : Whitley (1934:182) suggested that *Squalus waddi* is the earliest name for the Australian 'blind shark', which Bloch & Schneider described from an illustration of an Australian shark by Dr John Latham. I have not seen the illustration but provisionally accept Whitley's usage of *waddi* rather than *modestum* for the Blind Shark, which had considerable usage prior to Whitley's note.

Heteroscyllium Regan, 1908

BRACH Hete

Genus : *Heteroscyllium* Regan, 1908, *Ann.Mag.Nat.Hist.(Ser. 8)*, 2(11):455; (replacement name for genus *Brachaelurus* Ogilby, 1908, a junior homonym of genus *Brachaelurus* Ogilby, 1907).

Type Species : *Brachaelurus colcloughi* Ogilby, 1907, by original designation.

Synonymy : *Brachaelurus* Ogilby, 1908 (not Genus *Brachaelurus* Ogilby, 1907).

Diagnostic Features : No symphyseal groove on chin; nostrils subterminal on snout and well behind snout tip; spiracles small and well behind eyes. First dorsal fin noticeably larger than second dorsal; anal origin about under midbase of second dorsal fin, anal fin insertion separated from lower caudal origin by a space about equal to the anal inner margin; caudal fin rather long, length of its dorsal margin greater than distance from snout tip to pectoral fin insertion.

Remarks : See Bigelow & Schroeder (1948:180 ftn. 5) for a discussion of the nomenclatural history of this genus and *Brachaelurus*).

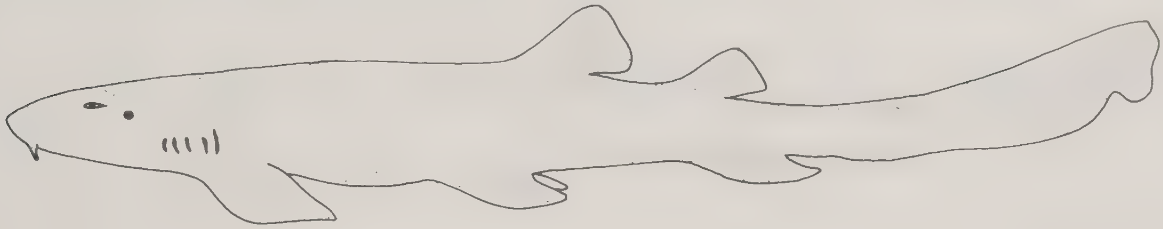
Heteroscyllium colcloughi (Ogilby, 1908)

BRACH Hete 1

Brachaelurus colcloughi Ogilby, 1908, *J.Proc.R.Soc.Queensl.*, 1907, 21:4. Holotype: A 457 mm immature male, originally no. 410, Amateur Fisherman's Association of Queensland Museum, apparently lost. Type Locality: Mud Island, Moreton Bay, Queensland, Australia.

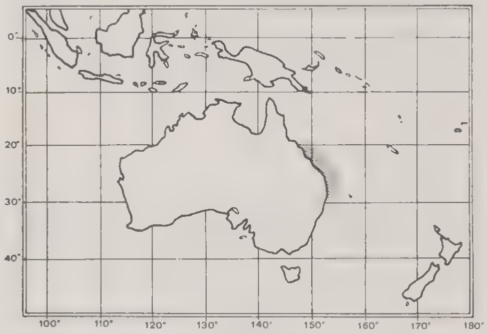
Synonymy : None.

FAO Names : En - Bluegray carpetshark; Fr - Requin aveugle gris-bleu; Sp - Tiburón ciego gris.



Field Marks : A small stout shark with long barbels, nasoral grooves and perinasal grooves, a short mouth ahead of the eyes, no symphyseal groove on the chin, no dermal lobes on sides of head, large spiracles, two spineless dorsal fins and an anal fin, the first dorsal larger than the second and with origin over the pelvic bases, a short precaudal tail and moderately long caudal fin, and colour grey above, white below.

Diagnostic Features : See genus.



Geographical Distribution : Western South Pacific: Australia (southern Queensland).

Habitat and Biology : A little-known tropical or subtropical inshore bottom shark of the Queensland continental shelf.

Size : Maximum total length about 60 cm.

Interest to Fisheries : None at present.

Literature : Whitley (1940); Fowler (1941); Grant (1972).

7.3 FAMILY ORECTOLOBIDAE Gill, 1896

ORE

Family Orectolobidae Gill, 1896a, Proc.U.S.Natl.Mus., 18(1057):212.

Synonymy : Subfamily Crossorhinae Swainson, 1838 (Family Squalidae).

FAO Names : En - Wobbegongs; Fr - Requins-tapis; Sp - Tiburones tapiceros.

Field Marks : These are distinctive flattened, variegated sharks, differing from all others in having narrow dermal flaps along the side of the head (except angel sharks, Squatinidae, which differ from wobbegongs in lacking anal fins); they also have long barbels, short, nearly terminal mouths in front of the eyes, nasoral grooves and perinasal grooves and flaps, symphyseal grooves, large spiracles, and dorsolateral eyes.

Diagnostic Features : Body considerably depressed, without ridges on sides. Head very broad and flattened, with unique lateral flaps of skin, snout truncated; eyes dorsolaterally situated on head, with subocular pockets; spiracles very large, larger than eyes and somewhat below and lateral to them; gill slits small, fifth well separated from fourth or close to it but not overlapping; internal gill slits without filter screens; nostrils with long, pointed or branched barbels and distinct circumnarial folds and grooves around outer edges of incurrent apertures; mouth fairly large, nearly terminal on head, and nearly transverse, with a symphyseal groove on chin; teeth strongly differentiated in jaws, with three rows of fanglike teeth at the upper symphysis and two rows at the lower; teeth with a medial cusp, lateral cusplets variably present or absent, and weak labial root lobes; tooth rows 23 to 26/19. Dorsal fins equal-sized, first dorsal with origin over or slightly behind the pelvic insertions and insertion far behind the pelvic rear tips; pectoral fins moderate-sized or large, broad and rounded, slightly larger than pelvic fins, with fin radials not expanded into fin web; pelvic fins larger than dorsals and anal fin; anal fin somewhat smaller than second dorsal, with its origin about opposite rear third of second dorsal base or insertion; anal fin with broad base and subangular apex, separated by a narrow notch much less than base length from lower caudal origin; caudal fin with its upper lobe hardly elevated above the body axis, less than a fourth as long as the entire shark, with a strong terminal lobe and subterminal notch but no ventral lobe. Caudal peduncle without lateral keels or precaudal pits. Supraorbital crests present on cranium, not laterally expanded. Valvular intestine of ring type. Colour pattern highly developed, including dark and light spots, dark saddles, rings, and reticulations on back.

Habitat, Distribution and Biology : These are common, largish flattened bottom sharks of warm-temperate to tropical continental waters of the western Pacific, occurring from the intertidal down to at least 110 m. They are most diverse in Australian and New Guinean waters, but occur northward to Japan. They are often found on rocky and coral reefs or on sandy bottom, where they lurk and are concealed in part by their cryptic coloration and dermal lobes on their heads. They are reportedly sluggish fishes, moving little, but can clamber around with their paired fins on the bottom and even climb partway out of the water while moving between tidepools. At least two species may attain a size of 3.2 to 3.7 m. These sharks are ovoviviparous, with large litters of 20 or more young. Wobbegongs are powerful bottom predators with heavy jaws and greatly enlarged, dagger-shaped, extremely sharp fanglike teeth in the front of their mouths. They feed on bottom fishes, crabs, lobsters, octopi, and other bottom animals. Wobbegongs can be dangerous when captured, provoked or stepped upon, and have inflicted severe lacerations on the limbs of people. There are even rare records of large wobbegongs attacking people and biting off their feet or killing them. Wobbegongs are often difficult to see against the bottom and can be contacted accidentally. These sharks should be treated with care because of their formidable dentition, even though they do not appear to be particularly aggressive unless provoked.

Interest to Fisheries : Wobbegongs are utilized for food in western Australia and off China, Japan, and probably elsewhere where they occur; their colorful skins are sometimes used for leather.

Remarks : The arrangement of this family is modified from Ogilby & McCulloch (1908), Regan (1908, 1909), Garman (1913), Whitley (1940) and Fowler (1941).

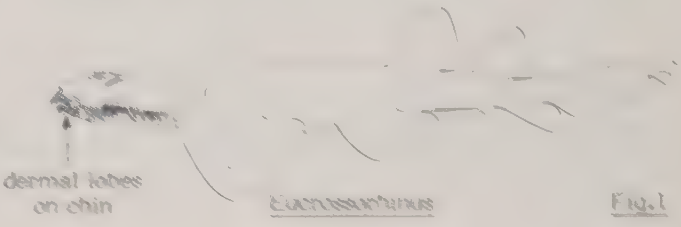
Key to Genera :

1a. Chin with dermal lobes. Body with a reticular pattern of narrow dark lines (Fig. 1) .... **Eucrossorhinus**

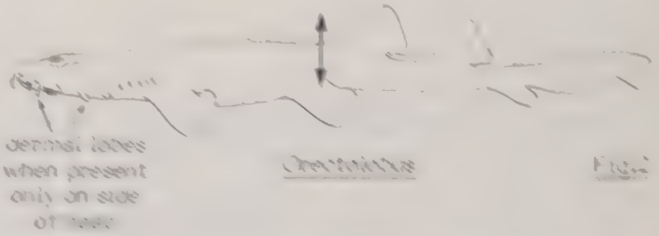
1b. Chin without dermal lobes. Colour pattern variable, but without a reticular pattern of narrow dark lines

    2a. Head and body without tubercles or with small ones or inconspicuous dermal ridges. Dorsal fins higher, height at least three-fourths of base length. Origin of first dorsal behind midbase of pelvics (Fig. 2) .... **Orectolobus**

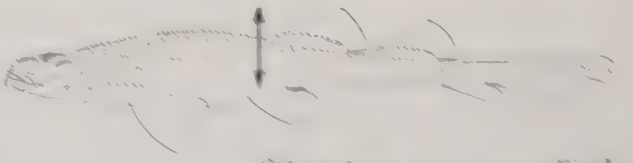
    2b. Head and body covered by large rounded tubercles. Dorsal fins long and low, height about half base. Origin of first dorsal anterior to pelvic midbases (Fig. 3) .... **Sutorectus**



Eucrossorhinus Fig.1



Orectolobus Fig.2



Sutorectus Fig.3

Eucrossorhinus Regan, 1908

ORE Eucro

Genus : Eucrossorhinus Regan, 1908a, Proc.Zool.Soc.Lond., 1908:357.

Type Species : Eucrossorhinus dasypogon Regan, 1908, by monotypy, equals Crossorhinus dasypogon Bleeker, 1867.

Synonymy : None.

Diagnostic Features : Head and body very broad, without enlarged tubercles on body, except for those above eyes. Trunk width across pectoral insertions about equal to head length. Precaudal tail rather short, distance from pelvic insertion to lower caudal origin about equal to head length. Head width slightly greater than its length from snout tip to fifth gill openings; chin with a bushy beard of highly branched dermal lobes; dermal lobes of sides and front of head highly branched and numerous, forming a virtually continuous fringe from snout tip to pectoral bases; nasal barbels branched, with complex multiple lobes. Dorsal fins high and short, height of first about equal to its base length, length of first dorsal base less than pelvic length from origin to free rear tip; origin of first dorsal fin opposite posterior fourth of pelvic bases; interspace between first and second dorsal fins longer than first dorsal inner margin and slightly more than half first dorsal base; pectoral and pelvic fins very large, distance from pectoral insertions to pelvic origins about equal to pectoral bases and less than pelvic bases from origins to free rear tips. Colour: dorsal surface with a reticular pattern of narrow dark lines on a light background, with scattered symmetrical enlarged dark dots at the junction of lines.

Remarks: This genus was originally proposed by Regan (1908) to separate *Crossorhinus dasypogon* from other wobbegongs primarily because of its supposedly even-spaced gill slits, but he also mentioned that the genus differed from *Orectolobus* by having a broader, more depressed head, smaller eyes, and wider spiracles. However, Regan (1909) reversed himself and rejected the genus because his new, similar *Orectolobus ogilbyi* had the last two gill slits close together.

Ogilby & McCulloch (1908), Fowler (1941), and Stead (1963) did not recognize the genus but Garman (1913), Whitley (1940), Bigelow & Schroeder (1948), Garrick & Schultz (1963), Compagno (1973), and Applegate (1974) all retained *Eucrossorhinus* as a genus. Examination of material convinces me that this genus is well-distinguished from other wobbegongs (as is indicated in the section on Diagnostic Features).

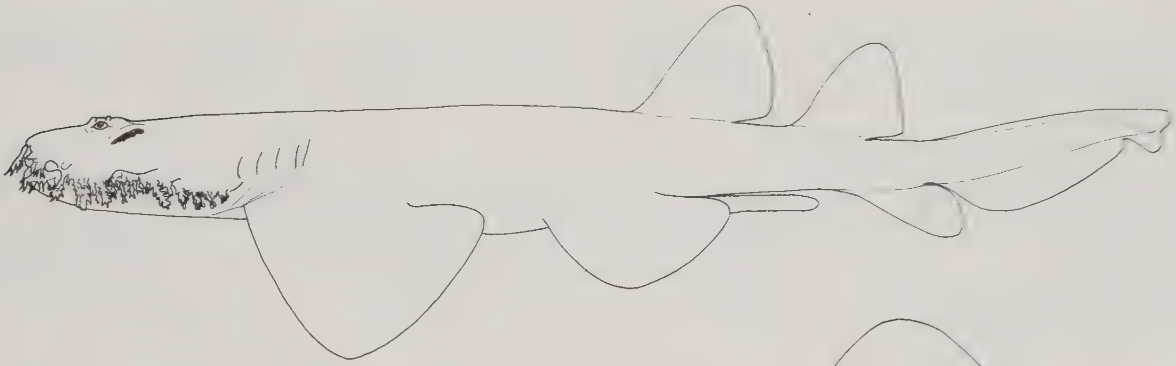
Eucrossorhinus dasypogon (Bleeker, 1867)

ORE Eucro 1

Crossohrinus dasypogon Bleeker, 1867, *Arch.Neerl.Sci.Nat.*, 2:400, pl. 21, fig. 1. Syntypes: British Museum (Natural History), BMNH 1867.11.28.209, 215 mm immature male, one of two described by Bleeker from Waigiu (Waigeo). Type Locality: Waigiu and Aru, Indonesia.

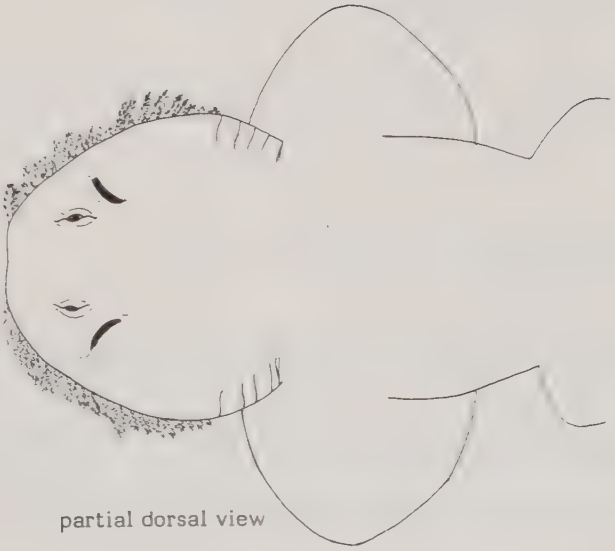
Synonymy: *Orectolobus ogilbyi* Regan, 1909 (see Remarks, below).

FAO Names: En - Tasselled wobbegong; Fr - Requin tapis barbu; Sp - Tapicero barbudo.

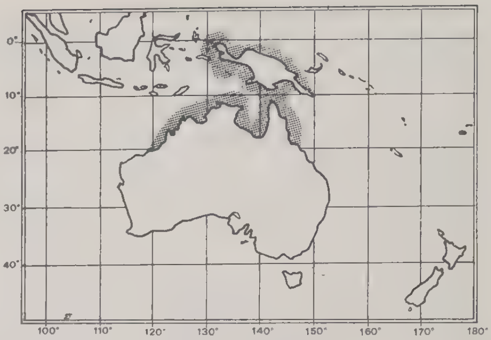


Field Marks: This squat, broad, angler-like shark with profuse, highly branched dermal lobes on its head, a beard of similar lobes on its chin, and reticulated colour pattern of narrow dark lines and dark spots at their junctions on a light background is unmistakable; also, mouth in front of eyes, a symphyseal groove on chin, very broad pectoral and pelvic fins, two spineless dorsal fins and an anal fin, the first dorsal origin opposite the pelvic hindbases, the anal origin well behind the second dorsal origin.

Diagnostic Features: See genus.



partial dorsal view



Geographical Distribution : Western South Pacific: Indonesia (Waigeo, Aru, Irian, Jaya), Papua New Guinea, ? Malaysia, Australia (northern Queensland, Northern Territory, Western Australia).

Habitat and Biology : A little-known inshore tropical bottom shark, present on coral reefs. Said to be a faster swimmer than other wobbegongs (Whitley & Pollard, 1980), but its more flattened shape and bushy beard of dermal flaps suggests the reverse, that it might be more sluggish than other wobbegongs. Probably ovoviviparous and probably feeding on bottom invertebrates and fishes. According to an informant quoted by Whitley (1940), this shark "...attacks and generally kills the natives" in Papua-New Guinea; this shark no doubt should be considered dangerous and to be treated with respect, but the fearsome reputation of this shark may be exaggerated. Divers have approached and photographed the tasselled wobbegong during the daytime, without inciting attacks, though probably stepping on or near this very well-camoflaged shark might cause it to bite at least in self-defense or by mistaking a human foot for its usual prey.

Size : Maximum total length said to be 366 cm but this is uncertain. An adult male examined by the writer from New Guinea is 117 cm long; the 22 cm syntype is newborn or close to it.

Interest to Fisheries : Uncertain, probably minimal; the tough skin with its handsome reticulated colour pattern is potentially valuable for leather.

Literature : Ogilby & McCulloch (1908); Regan (1908, 1909); Whitley (1940); Fowler (1941); Marshall (1965); Whitley & Pollard (1980).

Remarks : The separation of the Australian Eucrossorhinus ogilbyi (Regan, 1909) from this species is unsatisfactory. Regan (1909) distinguished the two as follows:

Ogilbyi. Gill slits decreasing in size from first to fourth, last larger; last two closer together than rest. Dermal lobes on sides of head in three separate groups. Origin of first dorsal fin well behind middle of total length. Distance between origins of dorsals nearly half that from origin of second dorsal to end of tail.

Dasypogon. First gill slit slightly smaller than rest, which are of equal size and equidistant. Dermal lobes on head in two separate groups. Origin of first dorsal fin in the middle of total length. Distance between origins of dorsals slightly more than 1/3 that from origin of second dorsal end of tail.

The present writer was able to compare the syntype listed above with a larger specimen of putative E. ogilbyi from northern Queensland (BMNH 1911.4.1.43, 415 mm female), as well as a much larger specimen of E. dasypogon from Papua New Guinea (Australian Museum, Sydney, AMS 14783, 117 cm adult male). This indicated that the characters supposed to separate the two species do not hold.

All three specimens had the last two gill slits more closely spaced than the other three, though the larger ogilbyi and dasypogon had them slightly closer than the small syntype. All three specimens have the first four gill slits about equal length or with the first slightly smaller; the fifth is slightly smaller than the fourth in the small dasypogon, slightly larger in the large dasypogon, and about equal to it in the ogilbyi. In the small dasypogon and the ogilbyi the first dorsal origin is actually slightly ahead of the midlength, and slightly behind in the large dasypogon (an indicator of allometric increase in abdominal length with growth). The small dasypogon has the first dorsal to second dorsal origin 2.7 in the distance from the second dorsal origin to the caudal tip, the ogilbyi 2.6, and the large dasypogon 2.4.

None of the differences listed above suggest anything more than individual and ontogenetic variation in a single species. As the three specimens examined are otherwise strikingly similar in colour pattern and general morphology, and there is nothing in the literature to suggest any significant differences between Australian, Papua New Guinean and Indonesian Eucrossorhinus, I propose to synonymize E. ogilbyi with E. dasypogon.

Orectolobus Bonaparte, 1834

ORE Ore

Genus : Subgenus Orectolobus Bonaparte, 1834 (Genus Scyllium Cuvier, 1817), Iconog.Fauna Italia, Pesci, 7 fasc., 1834 (no pp. nos.).

Type Species : Squalus barbatus Gmelin, 1789, by subsequent restriction of Gill (1896:211); a junior synonym of Squalus maculatus Bonnaterre, 1788.

Synonymy : Genus Crossorhinus Müller & Henle, 1837; Genus Sutorectus Whitley, 1939.

Diagnostic Features : Dorsal surface of head, body and precaudal tail, and dorsal fin bases smooth or with small inconspicuous tubercles or low longitudinal ridges, not noticeably warty. Trunk moderately broad, width across pectoral insertions considerably less than head length. Precaudal tail rather long, distance from pelvic insertion to lower caudal origin much greater than head length. Head narrow, its greatest width about equal or less than distance from snout tip to first gill openings; chin smooth, without a beard of dermal lobes; dermal lobes of sides and front of head small, short, unbranched or slightly branched, and forming isolated groups that are broadly separated from one another; nasal barbels simple and unbranched or with a weak basal branch. Interspace between first and second dorsal fins usually longer than first dorsal inner margin (slightly shorter than first dorsal inner margin in one species) and varying from over half to about a fifth of first dorsal base; dorsal fins fairly high and short to moderately long, height of first over 3/4 of its base length, length of first dorsal base less than pelvic length from origin to free rear tip; origin of first dorsal fin behind midbases of pelvics; pectoral and pelvic fins small and widely spaced from each other, distance from pectoral insertions to pelvic origins at least 1.5 times length of pectoral bases and somewhat greater than pelvic lengths from origins to free rear tips. Colour: dorsal surface with a colour pattern of regular or jagged-edged broad dark saddles separated by light areas with dusky blotches, scattered dark spots or semi-reticulated broad lines, or 0-shaped light spots on a dark background; no reticulating narrow lines with spots at their junctions, but broad reticulating lines without spots are present in at least one species.

Remarks : The present account of this genus follows Ogilby & McCulloch (1908), Regan (1908), Whitley (1940) in many details, but is regarded as highly provisional due to the limited amount of wobbegong material that could be examined in the time available. Particularly problematical is the status of subspecies in the species Orectolobus ornatus. Also, in western Australian waters there apparently is a distinct, undescribed species of wobbegong, that is very abundant and resembles O. ornatus as well as Sutorectus tentaculatus (B. Hutchins, pers. comm.).

Key to Species :

1a. Nasal barbels not branched. Dermal lobes of head very broad-based, only 2 or 3 in front of eyes. Colour pattern simple, dark rounded saddles with light outlining widely spaced by dusky areas and with a few dark spots; saddles on head and trunk forming conspicuous eyespots .... **O. wardi**

1b. Nasal barbels branched. Dermal flaps narrow-based and more numerous, 5 or more in front of eyes. Colour pattern with elaborate variegated spots and saddles

  2a. Back dark, with light 0-shaped markings obscuring darker saddles. About 8 to 10 dermal flaps below and in front of eyes .... **O. maculatus**

  2b. Back with dark colour variegated with light blotches and prominent saddle markings. About 5 or 6 dermal flaps below and in front of eyes

    3a. Back with light areas between dark saddles marked with broad reticulated dark lines .... **O. japonicus**

    3b. Back with light areas between dark saddles marked with dark, light centred blotches and spots, not reticulated lines .... **O. ornatus**

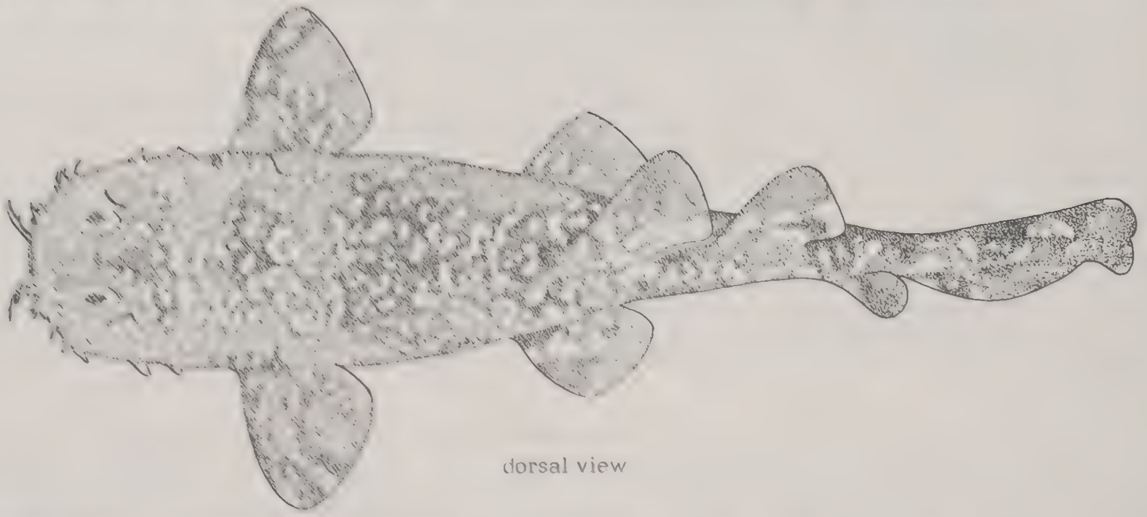
Orectolobus japonicus Regan, 1906

ORE Ore 1

Orectolobus japonicus Regan, 1906b, Ann.Mag.Nat.Hist.(Ser. 7), 18:435. Syntypes: British Museum (Natural History), 2 syntypes, 1000 and 780 mm. Type Locality: Japan.

Synonymy : None.

FAO Names: En - Japanese wobbegong; Fr - Requin-tapis moustache; Sp - Tapicero japonés.

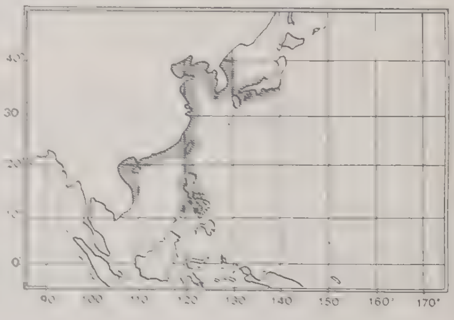


dorsal view

Field Marks: Flattened benthic sharks with dermal lobes on sides of head, symphyseal groove on chin, very conspicuous, variegated colour pattern of broad dark, dorsal saddles with light spots and corrugated edges, interspaced with light areas with dark broad reticular lines; also, mouth in front of eyes, long, basally branched nasal barbels, nasoral grooves and circumnarial grooves, two rows of enlarged fanglike teeth in upper jaw and three in lower jaw, first dorsal origin over pelvic bases.

Diagnostic Features: Nasal barbels with a few branches; five dermal lobes below and in front of eye on each side of head; no dermal tubercles or ridges on back. Origin of first dorsal fin behind midbases of pelvic fins; first dorsal height about equal to base length; interspace between dorsal fins longer than inner margin of first dorsal, about half first dorsal base. Colour pattern highly variegated and conspicuous, dorsal surface of body with conspicuous broad, dark rectangular saddles with deeply corrugated margins, dotted with light spots and not ocellate in appearance; interspaces between saddles light, with numerous broad reticulated lines.

Geographical Distribution: Western North Pacific: Japan, the Koreas, China, including Taiwan Island, Viet Nam, Philippines.



Habitat and Biology: A little-known temperate to tropical inshore bottom shark, nocturnal in habits. Ovoviviparous, with litters of up to 20 young. Eats fish, and presumably bottom invertebrates.

Size: A male was mature at 103 cm total length, maximum [illegible]

Interest to Fisheries: Probably limited, caught in setnets in Japan and used for human consumption; also taken in China, the Koreas and Viet Nam.

Literature: Ogilby & McCulloch (1908); Regan (1908); Fowler (1941); Herre (1953); Lindberg & Legeza (1959); Fourmanoir & Nhu-Nhung (1965); Matsubara (1955); Chen (1963); Masuda, Araga & Yoshino (1975).

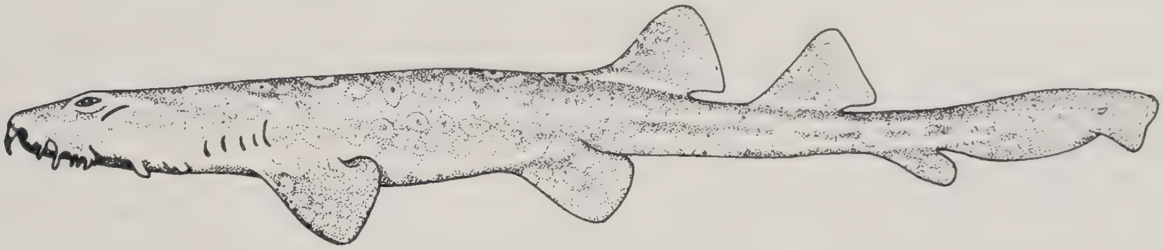
Orectolobus maculatus (Bonnaterre, 1788)

ORE Ore 2

Squalus maculatus Bonnaterre, 1788. Tabl.encyclop.méthod.trois reg.nat., Ichthyol., Paris, 8. Holotype: Unknown. Type Locality: "La mer du sud".

Synonymy: Squalus barbatus Gmelin, 1788; Squalus lobatus Bloch & Schneider, 1801; Squalus appendiculatus Shaw & Nodder, 1806; ? Squalus labiatus Bleeker, 1857 (nomen nudum ?).

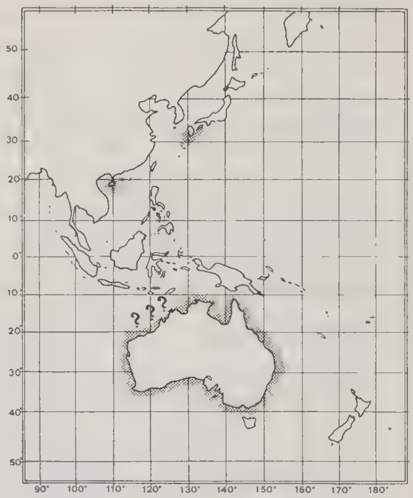
FAO Names : En - Spotted wobbegong; Fr - Requin-tapis tacheté; Sp - Tapicero manchado.



Field Marks : Flattened benthic sharks with dermal lobes on sides of head, symphyseal groove on chin, a rather somber, variegated colour pattern of dark back with obscure darker dorsal saddles and densely covered with prominent light O-shaped spots; also, mouth in front of eyes, long, basally branched nasal barbels, nasoral grooves and circumnarial grooves, two rows of enlarged fanglike teeth in upper jaw and three in lower jaw, first dorsal origin over pelvic bases.

Diagnostic Features : Head with 8 to 10 dermal lobes below and in front of eye on each side; nasal barbels with a few basal branches. No dermal tubercles or ridges on back. Origin of first dorsal fin about over last third of pelvic base; first dorsal height about equal to base length; interspace between dorsal fins longer than inner margin of first dorsal, about half length of dorsal base. Colour pattern variegated but more somber and less contrasting than most other wobbegongs except *O. wardi*, dorsal surface of body dark with somewhat obscure, broad, darker rectangular saddles with deeply corrugated margins separated by lighter areas, the entire dorsal surface densely spotted with large, O-shaped, light markings; saddles not ocellate in appearance; interspaces between saddles without broad reticulated lines.

Geographical Distribution : Western Pacific: Japan, South China Sea, Australia (Northern Territory, Western and South Australia, Queensland, New South Wales, Victoria).



Habitat and Biology : An abundant, temperate to tropical, inshore bottom shark of the continental shelves of the western Pacific, occurring in the intertidal down to at least 110 m, commonly on coral and rocky reefs, under piers, and on sand bottom. It may occur in water barely deep enough to cover it, and has been seen climbing over ridges between tidepools, with its back out of water. It apparently is sluggish and inactive and is often found quiescent on the bottom, at least during the day when it is presumably resting. It is well camoflaged by its colour pattern and dermal flaps on rough bottom but is rather conspicuous on sand. This species (and wobbegongs in general) has not been studied to the extent of some nurse sharks (Ginglymostomatidae), but site specificity may be a feature of its behaviour like nurse sharks; anecdotal accounts suggest that individuals may return to the same site repeatedly. It is said to be nocturnal, and may swim and clamber about the bottom at night looking for food like nurse sharks. It is not known how important their camoflage patterns are for feeding in this and other wobbegongs; it is uncertain if wobbegongs take a substantial amount of prey that simply blunders into proximity while they sit on the bottom, or if active prowling and stalking of prey at night is more important or their primary means of obtaining food. Wobbegongs in the Sydney area, presumably this common species, were observed to slowly sneak up to a bait at night from a considerable distance, as if stalking potential prey like a cat.

Ovoviviparous, with large numbers of young per litter; one female had 37. There are anecdotal accounts that male wobbegongs from the Sydney area (and presumably this species, which is abundant there) kept in aquaria fight vigorously among themselves while courting females, and that females are bitten by males in the gill region during courtship and one clasper is inserted; in captivity, these wobbegongs copulated in July. A wild male wobbegong was said to be attracted to a female kept in a wired enclosure open to the sea and tried to enter the enclosure during the breeding season; the implication is that the female gave off an attractive stimulus, presumably a chemical pheromone but possibly something else.

The spotted wobbegong feeds on bottom invertebrates, including crabs, lobsters and octopuses, and bony fishes including sea bass (Serranidae) and luderick (Kyphosidae). Prey items may blunder right up to the mouth of a lurking wobbegong, and even nibble on its tentacles, before being caught and devoured. Presumably the short broad mouth of this and other wobbegongs aids them in sucking in prey. The powerful jaws and big, modified anterior teeth in the symphyseal region of this and other wobbegongs, with one median and two lateral rows fanglike teeth in the lower jaw that interdigitate with two rows of lateral fangs in the upper jaw, form an effective trap to impale and kill their prey.

Much has been made of the danger of this and other wobbegongs to people, often to the exclusion of much else of their life history. This species has been known to bite people that step on it or put their feet near its mouth, and can and will bite when molested or provoked, as when speared or caught by line or nets; these sharks can inflict severe lacerations, and one case was reported of a fisherman losing his foot to a spotted wobbegong that was disturbed by the person as it sat in a rock pool. At least for this species, fatal attacks are virtually unknown. The strong jaws and jaw musculature, and (unlike nurse sharks) large and effective impaling teeth of these wobbegongs, coupled with their tendency to hold on after biting, makes them a minor hazard to unwary explorers of tide-pools, fishermen and divers, but the sharks otherwise appear to be relatively unaggresive and sluggish when unprovoked, as when a diver examines them underwater. However, placing one's limb near the head of a wobbegong may be inviting trouble, as the shark may attack either from misperceiving the limb as a smaller prey item, in response to being cornered by a possibly dangerous antagonist, or even in territorial defence. Several unprovoked attacks and a number of provoked attacks by Australian wobbegongs (probably including this species) on people, and even a few boat attacks, have been reported in the literature, but it is often difficult to determine which species was involved or what the precise circumstances were that led to the attack. Wobbegongs of all sizes, but especially larger individuals, should be regarded as potentially dangerous and should be treated with due respect.

Size : Maximum total length about 320 cm, most individuals smaller, up to 150 to 180 cm. Adult males may mature at about 60 cm long. Size at birth about 21 cm.

Interest to Fisheries : Limited, sometimes utilized for human consumption and for leather; the meat is apparently excellent eating and the skin of this and other wobbegongs is tough and makes an excellent, decorative leather with its handsome patterning. Spotted wobbegongs are commonly caught in trawls, beach seines, trammel nets, in lobster pots and traps, and with line gear. Some are taken by divers with spears. These sharks are regarded as a pest by lobster fishers, because they are adept at wedging themselves into lobster pots, to eat the catch and bait.

Literature : Ogilby & McCulloch (1908); Whitley (1940); Fowler (1941); Matsubara (1955); Chen (1963); Garrick & Schultz (1963); Stead (1963); Marshall (1965); Grant (1972).

Remarks : Extra-Australian records for this species require confirmation.

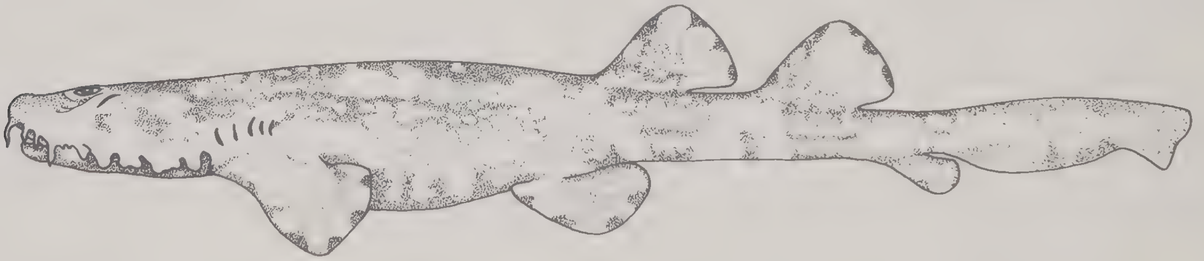
Orectolobus ornatus (de Vis, 1883)

ORE Ore 3

Crossorhinus ornatus de Vis, 1883, Proc.Linn.Soc.New S.Wales, 7:289. Holotype: ?. Type Locality: Queensland coast, Australia.

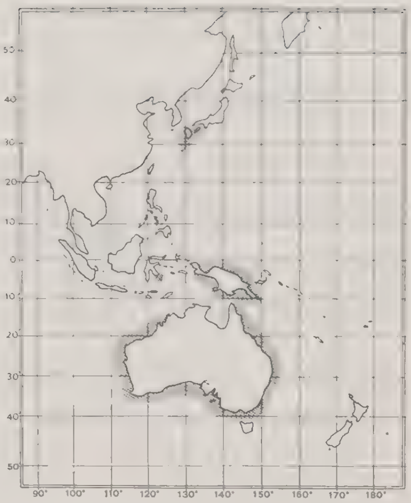
Synonymy : Orectolobus devisi Ogilby, 1916; Orectolobus ornatus halei Whitley, 1940.

FAO Names : En - Ornate wobbegong; Fr - Requin-tapis paste; Sp - Tapicero ornamentado.



Field Marks : Flattened benthic sharks with dermal lobes on sides of head, symphyseal groove on chin, a strongly contrasting, variegated colour pattern of conspicuous broad dark, dorsal saddles with light spots and corrugated edges, interspaced with lighter areas and conspicuous dark, light-centred spots; also, mouth in front of eyes, long, basally branched nasal barbels, nasoral grooves and circumnarial grooves, two rows of enlarged fanglike teeth in upper jaw and three in lower jaw, first dorsal origin over pelvic bases.

Diagnostic Features : Head with five dermal lobes below and in front of eye on each side; nasal barbels with a few branches; no dermal tubercles or ridges on back. Origin of first dorsal fin about over last third of pelvic base; first dorsal height about equal to base length; interspace between dorsal fins longer than inner margin of first dorsal, about half first dorsal base. Colour pattern very conspicuous and highly variegated, dorsal surface of body with conspicuous broad, dark rectangular saddles with deeply corrugated margins, dotted with light spots and not ocellate in appearance; interspaces between saddles light, with numerous broad light-centred dark blotches.



Geographical Distribution : Western Pacific: Japan, Indonesia (Irian Jaya), Papua New Guinea, Australia (Queensland, New South Wales, Victoria, South and Western Australia).

Habitat and Biology : A common inshore bottom shark of continental waters, found on algal-covered rocky areas and coral reefs. A nocturnal shark, that rests on the bottom during the day and prowls on its reef habitat at night. Ovoviviparous. Probably feeds on bottom invertebrates and fishes as does the spotted wobbegong (Orectolobus maculatus). Said to attack waders and fishermen in tidepools.

Size : Maximum total length about 288 cm; size at birth about 20 cm.

Interest to Fisheries : Very limited, skin very tough and attractively patterned, and making a good leather.

Literature : Ogilby & McCulloch (1908); Whitley (1940); Stead (1963); Marshall (1965); Grant (1972); Masuda, Araga & Yoshino (1975).

Remarks : Whitley (1940) proposed a subspecies, O. ornatus halei, for the ornate wobbegongs from South Australia, separable from O. o. ornatus of more northeastern waters by differences in its colour pattern and in the dermal flaps of the head. It remains to be seen at what level these apparent differences can be recognized.

Extra-Australian records for this species (Masuda, Araga & Yoshino, 1975, for Japan) require confirmation.

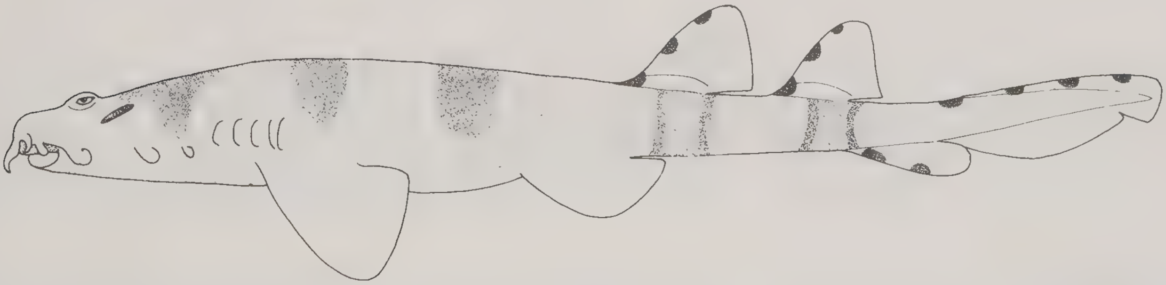
Orectolobus wardi Whitley, 1939

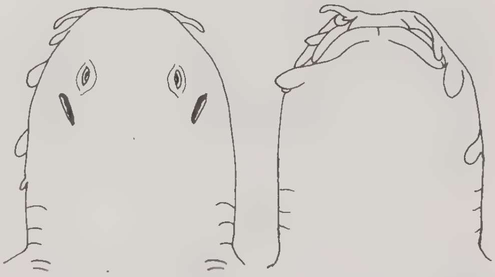
ORE Ore 4

Orectolobus wardi Whitley, 1939, Rec.Australian Mus., 20:264. Holotype: Australian Museum, Sydney 1AAMS7784, 375 mm female. Type Locality: Cape Keith, Melville Island, northern Australia.

Synonymy : None

FAO Names : En - Northern wobbegong; Fr - Requin-tapis savetier; Sp - Tapicero zapatilla.



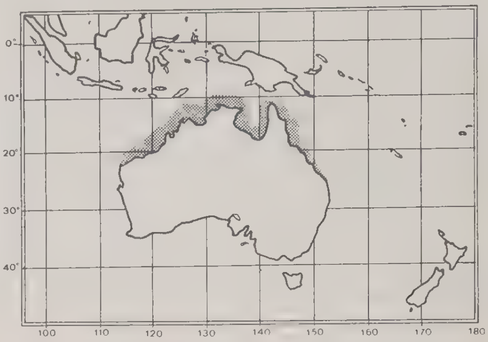


dorsal view of head underside of head

Field Marks : Flattened benthic sharks with dermal lobes on sides of head, symphyseal groove on chin, variegated but rather somber colour pattern of rounded, ocellate dark dorsal saddles with entire edging and light margins, interspaced with broad dusky areas without spots or reticular lines; also, mouth in front of eyes, long, basally branched nasal barbels, nasoral grooves and circumnarial grooves, two rows of enlarged fanglike teeth in upper jaw and three in lower jaw.

Diagnostic Features : Head with two dermal lobes below and in front of eye on each side; nasal barbels without branches. No dermal tubercles or ridges on back. Origin of first dorsal fin about over last fourth of pelvic base; first dorsal height about equal to base length; interspace between dorsal fins longer than inner margin of first dorsal, about half first dorsal base. Colour pattern variegated but dull and somber compared to most other wobbegongs, dorsal surface of body with small, rounded, ocellate, light-edged saddle marks with entire margins, separated from each other by broad, dusky spaces without spots or broad reticulated lines.

Geographical Distribution : Western South Pacific: Australia (Queensland, Northern Territory and Western Australia).



Habitat and Biology : A little-known but possibly common tropical inshore bottom shark of the Australian northern continental shelf, commoner in northern Australia than western Australia. Probably ovoviviparous. Presumably feeds on bottom invertebrates and fishes, but diet unrecorded.

Size : Maximum total length over 45 cm (immature specimens).

Interest to Fisheries : None at present.

Literature : Whitley (1939, 1940); Marshall (1965).

Sutorectus Whitley, 1939

ORE Sut

Genus : Sutorectus Whitley, 1939, Aust.Zool., 9(3):228.

Type Species : Crossorhinus tentaculatus Peters, 1864, by original designation.

Synonymy : None.

Diagnostic Features : Dorsal surface of head, body and precaudal tail, and dorsal fin bases, with rows of large, conspicuous dermal tubercles, resembling warts. Head rather narrow, its greatest width slightly less than distance from snout tip to first gill openings; chin smooth, without a beard of dermal lobes; dermal lobes of sides and front of head small, short, unbranched, and forming isolated groups that are broadly separated from one another; nasal barbels simple and unbranched. Trunk moderately broad, width across pectoral insertions considerably less than head length; precaudal tail rather long, distance from pelvic insertion to lower caudal origin much greater than head length. Dorsal fins low and long, height of first about half its base length, length of first dorsal base greater than pelvic length from origin to free rear tip; origin of first dorsal fin in front of midbases of pelvics; interspace between first and second dorsal fins much shorter than first dorsal inner margin and less than a fifth of first dorsal base; pectoral and pelvic fins small and widely spaced from each other, distance from pectoral insertions to pelvic origins about twice length of pectoral bases and somewhat greater than pelvic lengths from origins to free rear tips. Colour: dorsal surface with a colour pattern of jagged-edged broad dark saddles and scattered dark spots on a light background, no reticulating narrow lines with spots at their junctions.

Remarks : Whitley (1939) proposed the genus Sutorectus on the simple nasal barbels, tuberculate back, and narrower interdorsal space of the type and only species. This was recognized by Whitley (1940); Bigelow & Schroeder (1948), and Whitley & Pollard (1980) but considered a synonym of Orectolobus by Stead (1963) and Applegate (1974). The writer was inclined to Applegate's classification (e.g. Compagno, 1973c) prior to examining specimens of Sutorectus tentaculatus, but found additional characters by which this species may be distinguished from typical Orectolobus. The species tentaculatus is sufficiently aberrant to require some distinction from Orectolobus proper, but the Whitley-Bigelow & Schroeder generic arrangement adopted here may be alternatively downgraded to a subgenus of Orectolobus.

There is an undescribed species of Orectolobus from western Australia (B. Hutchins, pers.comm.) that the writer has examined, that shows a few characters, like its narrow interdorsal space, slightly lower dorsal fins, and longitudinal rows of small dermal knobs, that suggest that it is intermediate between typical Orectolobus and the bizarre Sutorectus tentaculatus. Further study of its morphology may indicate that Sutorectus should be ranked as a subgenus with the new species included in it, or the new species assigned to either the genus Orectolobus or Sutorectus.

Additional characters for Sutorectus are given in the Diagnostic Features section above. Sutorectus as a genus is phenetically closer to Orectolobus than the very distinct, highly derived and specialized Eucrossorhinus.

Sutorectus tentaculatus (Peters, 1864)

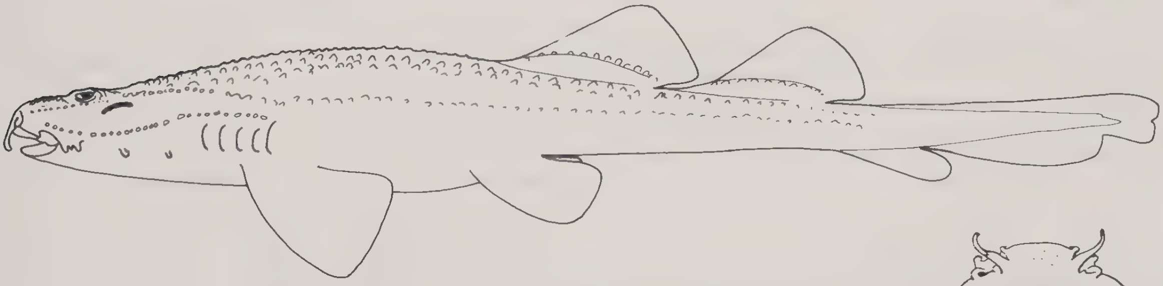
ORE Sut 1

Crossorhinus tentaculatus Peters, 1864, Monatsb.Akad.Wiss.Berlin, 123. Holotype: 900 mm. Type Locality: Port Adelaide, South Australia.

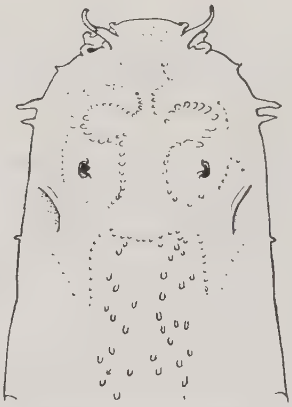
Synonymy : None.

Other Scientific Names Recently in Use : Orectolobus tentaculatus (Peters, 1864).

FAO Names : En - Cobbler wobbegong; Fr - Requin-tapis cordonnier; Sp - Tapicero zapatudo.



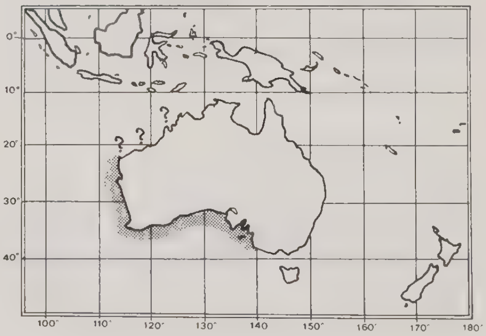
Field Marks : A rather slender wobbegong, less flattened than most, with a few slender dermal lobes on sides of head, simple, unbranched nasal barbels, symphyseal groove on chin, conspicuous warty tubercles in rows on the dorsal surface of the body and dorsal fin bases, dorsal fins very low and long, with heights half their base lengths, first dorsal origin in front of pelvic midbases, striking variegated colour pattern of broad dark, dorsal saddles wilth jagged, corrugated edges, interspaced with light areas with irregular dark spots; also, mouth in front of eyes, nasoral grooves and circumnarial grooves present, two rows of enlarged fanglike teeth in upper jaw and three in lower jaw.



dorsal view of head

Diagnostic Features : See genus.

Geographical Distribution : Western South Pacific: Confined to Australian waters (Western and South Australia).



Habitat and Biology : A little-known but probably common inshore bottom shark of temperate continental waters, on rocky and coral reefs. Biology almost unknown: presumably ovoviviparous and preying on bottom invertebrates and fishes.

Size : Maximum total length recorded 92 cm, but said to grow as large as the spotted wobbegong (Orectolobus maculatus) and hence possibly to 2 or 3 m length (Stead, 1963); near full-term young, still with sizeable yolk sacs, were 18 cm long.

Interest to Fisheries : Probably limited.

Literature : Ogilby & McCulloch (1908); Whitley (1940); Stead (1963).

7.4 FAMILY HEMISCYLLIIDAE Gill, 1862

HEMIS

Subfamily Hemiscylliinae Gill, 1862 (Family Scylliorhinoidae), Ann.Lyceum Nat.Hist.N.Y., 7(32):408.

Synonymy : Subfamily Chiloscylliinae Gill, 1862 (Family Scylliorhinoidae).

FAO Names : En - Bamboo sharks, Longtailed carpetsharks; Fr - Requins chabot; Sp - Bamboas.

Field Marks : Small, slender sharks with nasoral grooves, perinasal grooves, short barbels, small transverse mouths in front of eyes, dorsolateral eyes, large spiracles below eyes, no lateral skin flaps on head, two spineless dorsal fins, the second dorsal origin well ahead of the anal origin, a long, low keel-like rounded anal fin separated from the lower caudal origin by a narrow notch, and a long precaudal tail much greater than the head and body length.

Diagnostic Features : Body cylindrical or slightly depressed, with or without ridges on sides. Head narrow to moderately broad and cylindrical to somewhat flattened, without lateral flaps of skin, snout broadly rounded or slightly pointed; eyes dorsolaterally situated on head, without subocular pockets; spiracles very large, subequal in size to eyes and somewhat below them; gill slits small, fifth overlapping fourth; internal gill slits without filter screens; nostrils with short, pointed barbels and distinct circumnarial folds and grooves around outer edges of incurrent apertures; mouth small, subterminal on head, and nearly transverse, without a symphyseal groove on chin; teeth not strongly differentiated in jaws, with a medial cusp, lateral cusplets present or not, and weak labial root lobes; tooth rows 26 to 35/21 to 32. Caudal peduncle without lateral keels or precaudal pits. Dorsal fins equal-sized, first dorsal with origin varying from over the pelvic bases to well behind them and insertion well behind the pelvic rear tips; pectoral fins small, broad and rounded, as large as pelvic fins or slightly larger, with fin radials not expanded into fin web; pelvic fins about as large as dorsals but slightly larger than anal fin; anal fin somewhat smaller than second dorsal, with its origin behind second dorsal insertion; anal fin with broad base and broadly rounded, keel-like apex, separated by a narrow notch much less than base length from lower caudal origin; caudal fin with its upper lobe hardly elevated above the body axis, less than a fifth as long as the entire shark, with a strong terminal lobe and subterminal notch but no ventral lobe. Supraorbital crests present on cranium, not laterally expanded. Valvular intestine of ring type. Colour pattern of dark saddles and dark or light spots present, or colour plain.

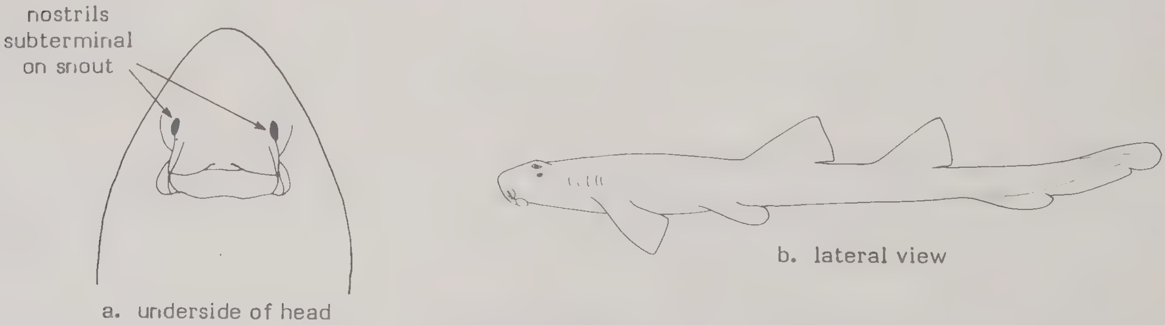
Habitat, Distribution and Biology : These are common, small, harmless, inshore bottom sharks of continental waters of the tropical western Pacific, ranging from Madagascar in the west to Japan, the Philippines, and the Australian region in the east. One genus (Hemiscyllium) is confined to Australia and New Guinea, but the second (Chiloscyllium) is wide-ranging. They commonly occur in the intertidal, in tidepools on rocky or coral reefs close inshore, sometimes in water sufficient only to cover them. Their slender bodies and strong, muscular, leg-like paired fins are ideal for clambering on reefs and in crevices. These sharks are small, less than 1 m maximum length. At least some of the species are oviparous, depositing eggs on the bottom in oval egg cases. Food of these sharks is little known, but probably includes small bottom fishes and invertebrates. Several of the species are very hardy and can live over a decade in captivity and even reproduce there.

Interest to Fisheries : Hemiscyllium species are little utilized for fisheries, but Chiloscyllium species are commonly caught in smallscale artisanal fisheries and by bottom trawlers in the western Pacific and eastern central Indian Ocean.

Remarks : The arrangement of this family follows Garman (1913), Fowler (1941) and Whitley (1967).

Key to Genera :

1a. Nostrils subterminal on snout (Fig. 1a). Eyes and supraorbital ridges hardly elevated. Preoral snout long, mouth closer to eyes than snout tip. No black hood on head or large dark spot or spots on sides of body above pectoral fins (Fig. 1b) .... **Chiloscyllium**

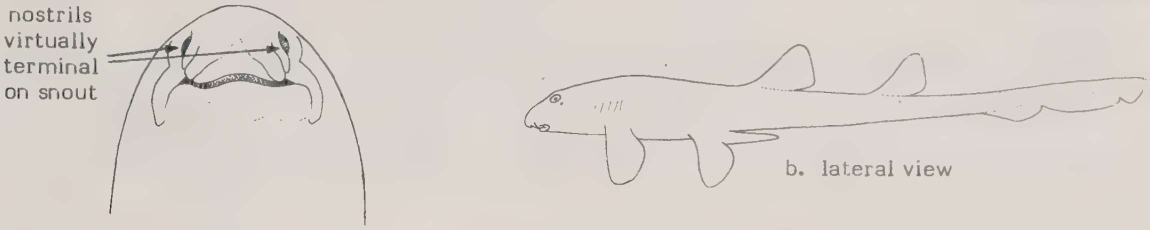


a. underside of head

b. lateral view

Chiloscyllium Fig.1

1b. Nostrils terminal on snout (Fig. 2a). Eyes and supraorbital ridges prominently elevated. Preoral snout short, mouth closer to snout tip than eyes. A large dark spot or spots on sides of body above pectoral fins, or a black hood on head (Fig. 2b) .... **Hemiscyllium**



a. underside of head

Hemiscyllium Fig.2

Chiloscyllium Müller & Henle, 1837

HEMIS Chilo

Genus : Chiloscyllium Müller & Henle, 1837, Ber.K.Preuss.Akad.Wiss.Berl., 2:112 (no species mentioned).

Type Species : Scyllium plagiosum Bennett, 1830, by subsequent monotypy of Müller & Henle, in Smith, 1837, Proc.Zool.Soc.Lond., 5:85; also by subsequent designation of Gill, 1862, Ann.Lyceum Nat.Hist.N.Y., 7:408.

Synonymy : Synchismus Gill, 1862.

Diagnostic Features : Snout relatively long, nostrils subterminal and well separated from snout tip. Eyes and supraorbital ridges hardly elevated. Mouth slightly closer to eyes than snout tip. Lower labial folds usually connected across chin by a dermal fold. Pectoral and pelvic fins relatively thin, not heavily muscular. No black hood on head or large dark spot or spots on sides of body above pectoral fins.

Remarks : The arrangement of this genus follows Garman (1913) and Fowler (1941). The genus is long overdue for a detailed systematic review from a large number of specimens from different localities, and the arrangement of the genus presented here is very tentative. The six species recognized here are probably valid, but there may be additional species that are being confused with the valid ones (especially with C. griseum and C. punctatum).

Key to Species :

1a. Body and tail very slender. Anal fin origin far behind free rear tip of second dorsal, length of anal fin from origin to free rear tip subequal to length of hypural caudal lobe from lower caudal origin to subterminal notch. Colour pattern with numerous small dark spots and bars .... **C. indicum**

1b. Body and tail moderately slender to relatively stout. Anal fin origin below or close behind free rear tip of second dorsal, length of anal fin considerably shorter than hypural caudal lobe. Colour pattern varied but without numerous small dark spots and bars

  2a. Ground colour of body dark with numerous light spots

    3a. Dorsal fins large and angular, snout tip truncated. Colour pattern without transverse dark bands, spots blue .... **C. caerulopunctatum**

    3b. Dorsal fins smaller and more rounded, snout tip broadly rounded. Colour pattern with transverse broad dark saddles, spots white .... **C. plagiosum**

  2b. Ground colour of body light, with or without scattered dark spots or dusky bands

    4a. Dorsal fins smaller than pelvic fins, dorsals without projecting free rear tips .... **C. griseum**

    4b. Dorsal fins larger than pelvic fins, dorsals with projecting free rear tips

      5a. A lateral ridge present on each side of trunk. First dorsal origin over or behind pelvic fin bases. No colour pattern .... **C. arabicum**

      5b. No lateral ridges on trunk. First dorsal origin over anterior halves of pelvic fin bases. A colour pattern of saddles and a few scattered dark spots in young .... **C. punctatum**

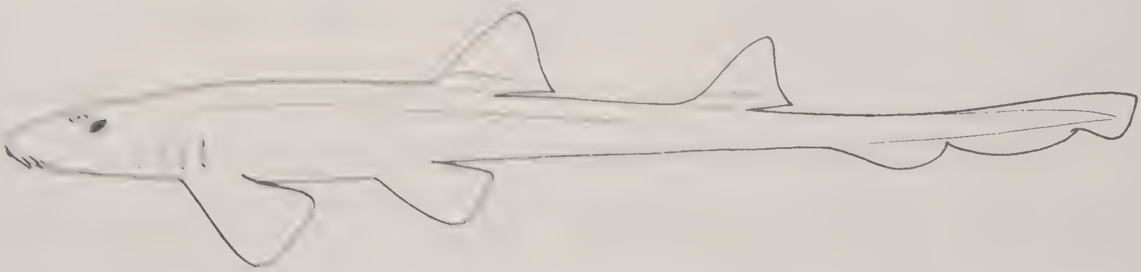
Chiloscyllium arabicum Gubanov, 1980

HEMIS Chilo 3

Chiloscyllium arabicum Gubanov, in Gubanov & Schleib (eds), 1980, Sharks of the Arabian Gulf, 14, figs 6-7, pl. Holotype: Uncertain. Type Locality: Persian Gulf.

Synonymy : None.

FAO Names : En - Arabian carpetshark; Fr - Requin-chabot camot; Sp - Bamboa arábiga.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, greatly elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, lateral ridges on trunk, dorsal fins with elongated free rear tips, first dorsal origin opposite or just behind pelvic insertions, no colour pattern.

Diagnostic Features : Body and tail moderately slender. Snout fairly thick and rounded anteriorly; a lateral ridge present on each side of trunk. Dorsal fins large and angular, somewhat larger than pelvic fins, dorsals with projecting free rear tips; interdorsal space very long, over twice first dorsal base; first dorsal origin over or behind pelvic fin bases; origin of anal fin somewhat behind free rear tip of first dorsal, anal fin length from origin to free rear tip somewhat less than hypural caudal lobe from lower caudal origin to free rear tip. No colour pattern, colour light brown.

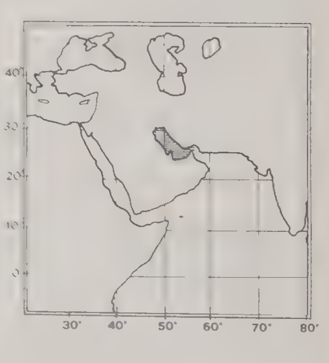
Geographical Distribution : As presently known confined to the "Gulf" between Iran and the Arabian Peninsula.

Habitat and Biology : A common inshore to offshore bottom shark in the "Gulf", especially during the summer, depths from 3 to 100 m.

Size : Maximum total length 70 cm.

Interest to Fisheries : Minimal at present, apparently little utilized in the "Gulf" (Gubanov & Schleib, 1980).

Literature : Gubanov & Schleib (1980).



Remarks : This inadequately described species is apparently very close to C. punctatum, but is provisionally recognized here.

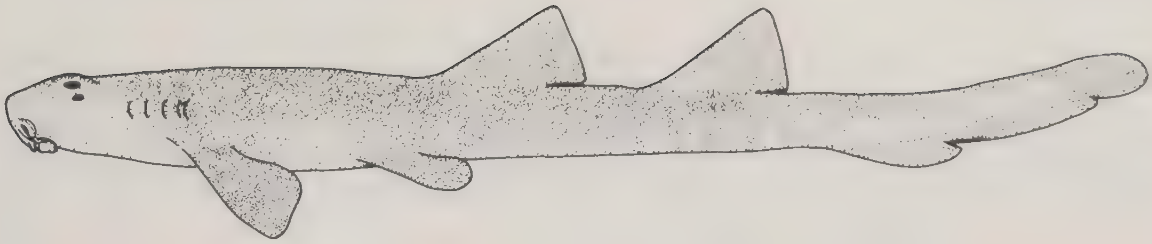
Chiloscyllium caeruleopunctatum Pellegrin, 1914

HEMIS Chilo 4

Chiloscyllium caeruleopunctatum Pellegrin, 1914, Bull.Soc.Zool.France, 39:230. Holotype: Muséum National d'Histoire Naturelle, Paris, 670 mm female. Type Locality: Fort Dauphin, Madagascar.

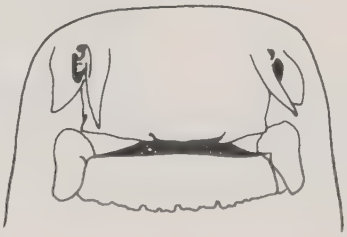
Synonymy : None.

FAO Names : En - Bluespotted bambooshark; Fr - Requin-chabot à taches bleues; Sp - Bamboa estrellada.



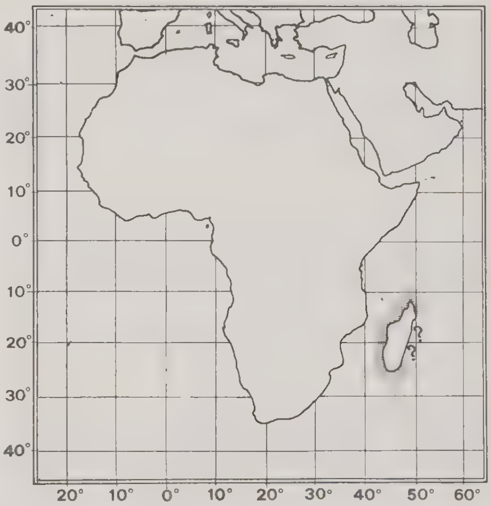
Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, greatly elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, lateral ridges on trunk, dorsal fins very large, colour dark with light blue spots but no dark saddles.

Diagnostic Features : Body and tail stout, snout thick and truncated anteriorly; a lateral ridge present on each side of trunk. Dorsal fins very large and angular, considerably larger than pelvic fins, dorsals without projecting free rear tips; interdorsal space very short, less than first dorsal base; first dorsal origin over pelvic fin bases; origin of anal fin slightly behind free rear tip of first dorsal, anal fin length from origin to free rear tip considerably less than hypural caudal lobe from lower caudal origin to free rear tip. Colour pattern of light blue spots on a dark grey-brown background, but no dark transverse bands.



underside of head

dermal denticles



Geographical Distribution : Western Indian Ocean: Madagascar. Until recently only known from the holotype. Dr Marie-Louise Bauchot and Ms Gabriella Bianchi (pers.comm.) recently saw this species in market catches in Madagascar, confirming the occurrence of the species there.

Habitat and Biology : A rare and little-known carpetshark, apparently confined to Madagascar. Virtually nothing is known of its biology.

Size : Maximum total length at least 67 cm.

Interest to Fisheries : None at present.

Literature : Bass, d'Aubrey & Kistnasamy (1975b); M.-L. Bauchot & G. Bianchi (pers. comm.).

Remarks : Fowler (1941) synonymized this species with the similar C. plagiosum, but Bass, d'Aubrey & Kistnasamy (1975b) retained it as a valid species without comparing it with C. plagiosum or other Chiloscyllium species. After comparing the redescription of the holotype of C. caerulopunctatum in Bass, d'Aubrey & Kistnasamy (1975b) with specimens of C. plagiosum I tentatively recognize this species as being valid. It apparently differs from C. plagiosum in having larger dorsal fins, a shorter, blunter snout, possibly wider mouth, and a different coloration, with smaller blue rather than white spots and lighter ground colour.

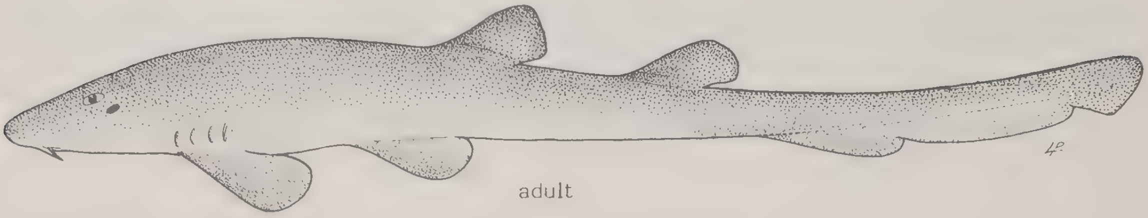
Chiloscyllium griseum Müller & Henle, 1838

HEMIS Chilo 1

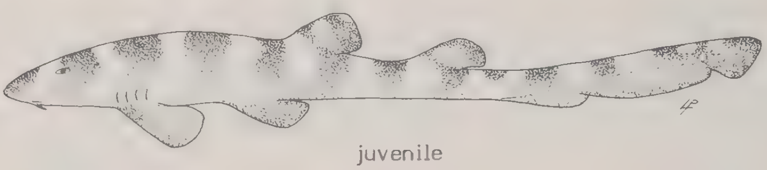
Chiloscyllium griseum Müller & Henle, 1838, Syst.Beschr.Plagiost., pt. 1:19, pl. 4. Holotype: Muséum National d'Histoire Naturelle, Paris. Type Locality: "Indien. Japan."

Synonymy : Scyllium griseum van Hasselt, 1824 (? nomen nudum); ? Chiloscyllium obscurum Gray, 1851 (nomen nudum); Chiloscyllium hasseltii Bleeker, 1852.

FAO Names : En - Grey bambooshark; Fr - Requin-chabot gris; Sp - Bamboa gris.



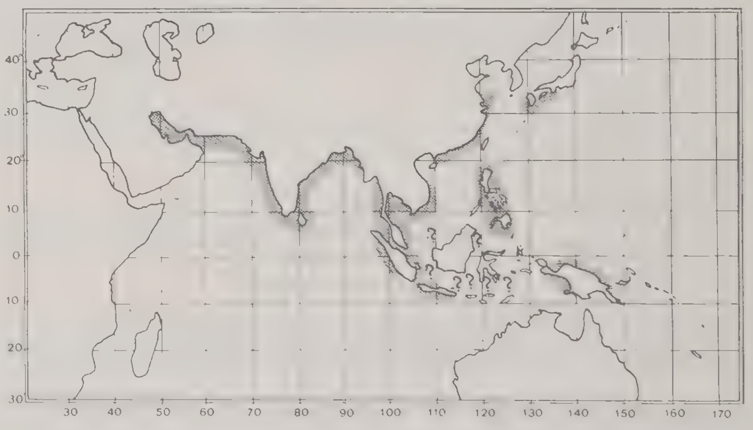
adult



juvenile

Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, greatly elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, no lateral ridges on trunk, dorsal fins without elongated free rear tips, first dorsal origin about opposite pelvic insertions, often no colour pattern in adults, but transverse bands in young.

Diagnostic Features : Body and tail fairly stout; snout rounded anteriorly; no lateral ridges on trunk. Dorsal fins fairly large and rounded, somewhat smaller than pelvic fins, dorsals without projecting free rear tips; interdorsal space short, slightly greater than first dorsal base; first dorsal origin about over pelvic fin insertions; origin of anal fin slightly behind free rear tip of first dorsal, anal fin length from origin to free rear tip somewhat less than hypural caudal lobe from lower caudal origin to free rear tip. Colour: adults usually light brown, without a colour pattern, but young with prominent dark transverse bands.



Geographical Distribution : Indo-West Pacific: The "Gulf" between Iran and the Arabian Peninsula, Pakistan, India, Malaysia, Thailand, Indonesia, China, Japan, the Philippines, Papua New Guinea.

Habitat and Biology : A common inshore bottom shark. Oviparous, deposits eggs in small, oval egg cases on the bottom. Probably feeds mainly on invertebrates.

Size : Maximum total length at least 74 cm.

Interest to Fisheries : Regularly taken in inshore fisheries off Pakistan, India and Thailand, and utilized for human food.

Literature : Garman (1913); Fowler (1941); Gubanov & Schleib (1980).

Remarks : This species was described as new by Müller & Henle without mention of the earlier *Scyllium griseum* van Hasselt, 1824. Fowler (1941) considered van Hasselt's species as without description, but I have not seen its original account and so list it as a tentative *nomen nudum* at present. Quite likely Müller & Henle based their *C. griseum* on the earlier *Scyllium* griseum, as they were apparently aware of van Hasselt's work in Java.

Chiloscyllium indicum (Gmelin, 1789)

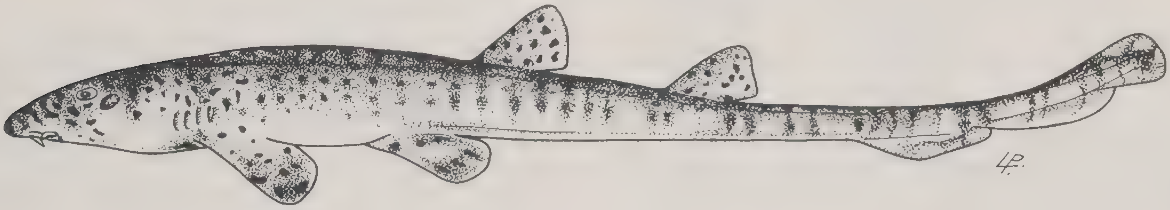
HEMIS Chilo 2

Squalus indicus Gmelin, 1789, Caroli Linnaei Syst.Nat., 1(3):1503. Holotype: None ? Type Locality: "Oceano Indico".

Synonymy : ?(Squalus) colax Meuschen, 1781 (nonbinomial?); Squalus tuberculatus Bloch & Schneider, 1801; Squalus gronovianus Shaw, 1804; ? Squalus (Scyliorhinus) dentatus Blainville, 1816 (name only); Chiloscyllium phymatodes Bleeker, 1852; Squalus caudatus Gronow, in Gray, 1854.

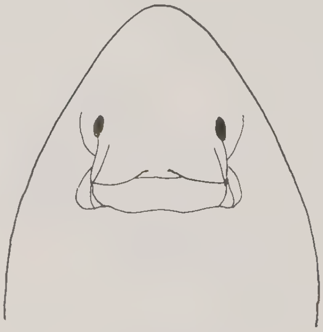
Other Scientific Names Recently in Use : Chiloscyllium colax (Meuschen, 1781).

FAO Names : En - Slender bambooshark; Fr - Requin-chabot élégant; Sp - Bamboa elegante.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, greatly elongated slender precaudal tail, long and low anal fin just anterior to caudal fin, lateral ridges on trunk, dorsal fins without elongated free rear tips, first dorsal origin opposite or just behind pelvic insertions, colour pattern of numerous small dark spots and dashes.

Diagnostic Features : Body and tail very slender; snout narrowly rounded anteriorly; a lateral ridge present on each side of trunk. Dorsal fins small and rounded, smaller than pelvic fins, and without projecting free rear tips; interdorsal space fairly long, nearly twice first dorsal base; first dorsal origin over or behind pelvic fin bases; origin of anal fin far behind free rear tip of first dorsal, anal fin length from origin to free rear tip about equal hypural caudal lobe from lower caudal origin to free rear tip. A colour pattern of numerous dark brown or blackish spots and dashes on light brown background.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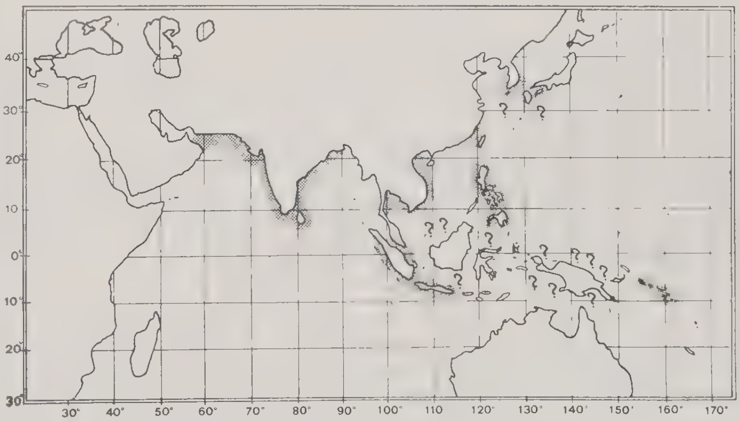
Geographical Distribution : Indo-West Pacific: Arabian Sea to India, Sri Lanka, Singapore, Thailand, Indonesia, Viet Nam, Taiwan Island, ? Republic of Korea, ? Japan, the Philippines, Solomon Islands.



Habitat and Biology : A common but little-known inshore bottom shark. Oviparous.

Size : Maximum total length about 65 cm.

Interest to Fisheries : Regularly taken in inshore fisheries in India, Sri Lanka and Thailand, and utilized for human food.

Literature : Garman (1913); Fowler (1941); Gubanov & Schleib (1980).

Remarks : Whitley (1939) proposed that Squalus colax Meuschen, 1781 was the earliest name for this species, but reference to that work (Meuschen, 1781) indicates that although colax apparently refers to the Gronow species later named Squalus indicus, it was never proposed in a binomial form but simply listed as colax. Apparently colax is nonbinomial, and is not available for this species.

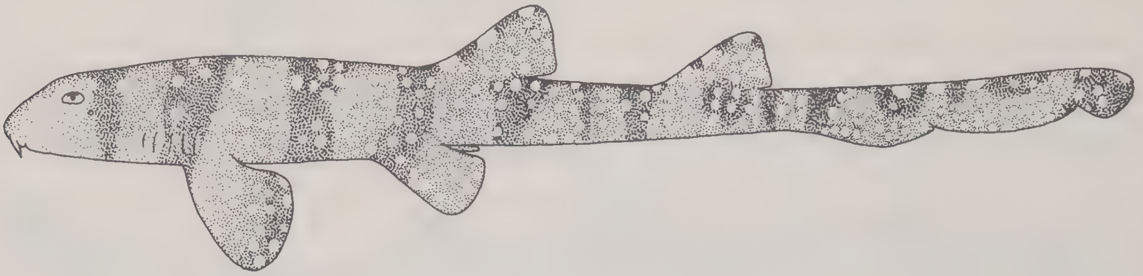
Chiloscyllium plagiosum (Bennett, 1830)

HEMIS Chilo 5

Scyllium plagiosum Bennett, 1830, Mem.life serv.Sir Stamford Raffles, Fishes, 694. Holotype: None?. Type Locality: Sumatra.

Synonymy : Scyllium ornatum Gray, 1832; Chiloscyllium plagiosum var. interruptum Bleeker, 1852.

FAO Names : En - Whitespotted bambooshark; Fr - Requin-chabot à taches blanches; Sp - Bamboa punteada.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, greatly elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, lateral ridges on trunk, dorsal fins without elongated free rear tips, first dorsal origin opposite or just behind pelvic insertions, colour pattern of numerous white spots and transverse bands on a dark background.

Diagnostic Features : Body and tail fairly stout; snout rounded anteriorly; a lateral ridge present on each side of trunk. Dorsal fins moderately large and rounded or angular, about equal in size to pelvic fins, dorsals without projecting free rear tips; interdorsal space short, slightly over length of first dorsal base; first dorsal origin over or behind pelvic fin bases; origin of anal fin somewhat behind free rear tip somewhat less than hypural caudal lobe from lower caudal origin to free rear tip. Colour: a prominent colour pattern of numerous white spots on a dark brown background, with darker brown or blackish transverse bands.

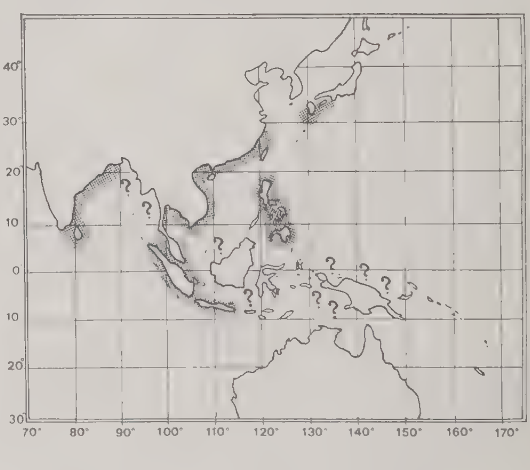
Geographical Distribution : Indo-West Pacific: India, Sri Lanka, ? Malaysia, Singapore, Thailand, Indonesia, Viet Nam, China, including Taiwan Island, Japan, the Philippines.

Habitat and Biology : A common but little-known inshore bottom shark. Oviparous.

Size : Maximum total length 95 cm, adult males 67 to 69 cm, an adult female 95 cm.

Interest to Fisheries : Regularly taken in inshore fisheries in India, Thailand, China, and utilized for human consumption.

Literature : Garman (1913); Fowler (1941); Chen (1963); Gubanov & Schleib (1980).



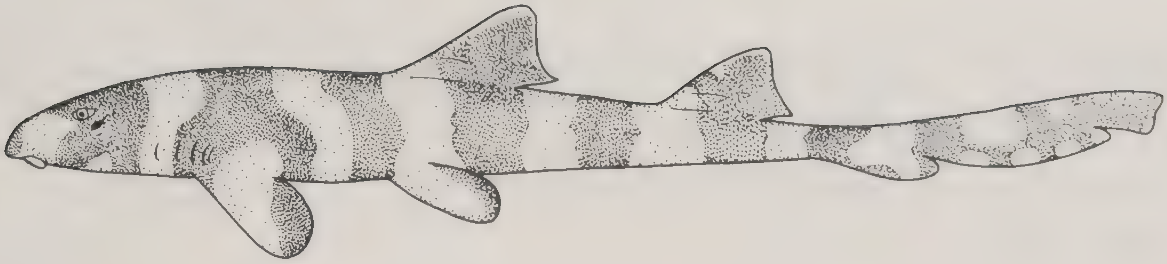
Chiloscyllium punctatum Müller & Henle, 1838

HEMIS Chilo 6

Chiloscyllium punctatum Müller & Henle, 1838, Syst.Beschr.Plagiost., pt. 1:19, pl. 4. Holotype: Rijksmuseum van Natuurlijke Historie, Leiden. Type Locality: Java.

Synonymy : ? Squalus (Scyliorhinus) russellianus Blainville, 1816 (nomen nudum); Scyllium punctatum van Hasselt, 1823; Chiloscyllium margaritiferum Bleeker, 1964.

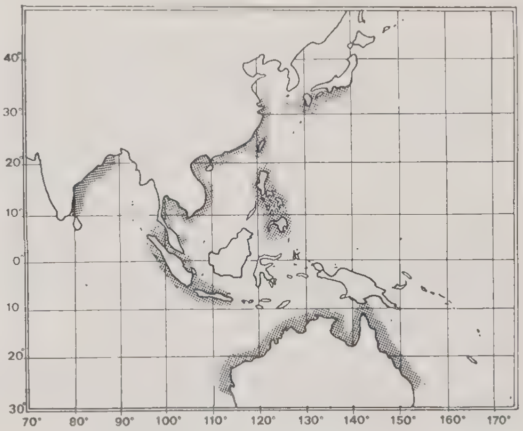
FAO Names : En - Brownbanded bambooshark; Fr - Requin-chabot bambou; Sp - Bamboa estriada.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, greatly elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, no lateral ridges on trunk, dorsal fins with elongated free rear tips, first dorsal origin opposite anterior halves of pelvic bases, usually no colour pattern in adults but young with transverse bands and a few dark spots.

Diagnostic Features : Body and tail moderately slender; snout rounded anteriorly; no lateral ridges on trunk. Dorsal fins large and angular, somewhat larger than pelvic fins, dorsals with projecting free rear tips; interdorsal space fairly short, slightly greater than first dorsal base; first dorsal origin over anterior halves of pelvic bases; origin of anal fin somewhat behind free rear tip of first dorsal, anal fin length from origin to free rear tip somewhat less than hypural caudal lobe from lower caudal origin to free rear tip. Colour light brown in adults, usually without a colour pattern, but young with dark transverse spots and usually a scattering of small blackish spots.

Geographical Distribution : Indo-West Pacific: India, Malaysia, Singapore, Thailand, Indonesia, Viet Nam, China (including Taiwan Island), Japan, the Philippines, Australia (Northern Territory, Western Australia, Queensland).



Habitat and Biology : A common inshore bottom shark found on coral reefs, often in tidepools. Very tenacious of life, can survive out of water for a long period (half a day). Oviparous, deposited in rounded egg cases. Gills sometimes infested by larval isopods (Praniza-larva of the isopod Gnathia).

Size : Maximum total length about 104 cm.

Interest to Fisheries : Regularly taken in inshore fisheries in India and Thailand, and utilized for human food. In Australia it is taken in beach seines and on hook-and-line and is said to prefer squid bait; it is little utilized but regarded as good eating.

Literature : Garman (1913); Whitley (1940); Stead (1963); Marshall (1964); Gubanov & Schleib (1980); Whitley & Pollard (1980).

Remarks : Müller & Henle listed "Scyllium punctatum Kuhl & van Hasselt" under their Chiloscyllium punctatum, but I was unable to examine Kuhl and van Hasselt's (or van Hasselt's) account of their species and so could not determine if Scyllium punctatum as proposed by them was a valid species and not a nomen nudum. As a present expedient I list Müller & Henle's account as the first valid description of this species. Fowler (1967, Catalog of World Fishes Part VI:103) termed this species Chiloscyllium russellianum, because the Squalus (Scyliorhinus) russellianus of Blainville (1816) was "assumed as based on Bokee sorah Russell, F. of Coromandel I 1803, 10 pl. 16. Vizagapatam, India" (Fowler, 1967a). However, Fowler (1941) had earlier hesitated to replace the well-used C. punctatum with Blainville's nomen nudum (even if Blainville's use of the name russellianus indicated a possibly recognizable species), which is followed here.

Hemiscyllium Müller & Henle, 1837

HEMIS Hemis

Genus : Hemiscyllium Müller & Henle, in Smith, 1837, Proc.Zool.Soc.Lond., 5:86 (name and species); also Müller & Henle, 1838, Ann.Mag.Nat.Hist., 2:34 (definition).

Type Species : Squalus ocellatus Bloch & Schneider, 1801, by monotypy, equals S. ocellatus Bonnaterre, 1788.

Synonymy : None.

Diagnostic Features : Snout relatively short, nostrils virtually terminal on snout tip; eyes and supraorbital ridges well elevated; mouth slightly closer snout tip than eyes; lower labial folds not connected across chin by a dermal fold. Pectoral and pelvic fins thick and heavily muscular. Colour: either a black hood on head or large dark spot or spots on sides of body above pectoral fins.

Remarks : The arrangement of this genus follows Fowler (1941) and Whitley (1940, 1967).

Key to Species :

1a. Head and snout with an abrupt black hood. Body with conspicuous large white spots .... **H. strahani**

1b. Head and snout light, without a black hood but with conspicuous black spots above pectoral fins. Body with light spots inconspicuous or absent

- 2a. Black spot behind gills small, not in the form of a conspicuous ocellus .... **H. freycineti**

- 2b. Black spot behind gills large, in the form of a conspicuous ocellus, ringed with white

  - 3a. Body covered with numerous, densely clustered dark small and large spots that form a reticular network of light ground colour between them. Dark crossbands strong on ventral surface of tail .... **H. trispeculare**

  - 3b. Body with sparse, large dark spots that do not form a reticular network of light ground colour between them. Dark crossbands not reaching ventral surface of tail

    - 4a. Lateral ocellus not surrounded by large black spots. Spots present on head in front and below eyes .... **H. ocellatum**

    - 4b. Lateral ocellus surrounded by large black spots. Spots absent from head in front and below eyes .... **H. hallstromi**

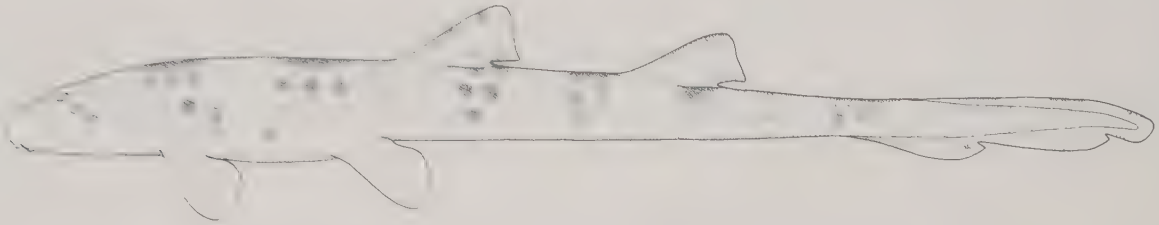
Hemiscyllium freycineti (Quoy & Gaimard, 1824)

HEMIS Hemis 1

Scyllium freycineti Quoy & Gaimard, 1824, Voy.aut.Monde corvettes S.M. l'Uranie et la Physicienne, 1817-20, Zool.:192. Syntypes: Muséum National d'Histoire Naturelle, Paris, MNHN A. 7792, two, 250 and 300 mm. Type Locality: Waigiu (Waigeo), Indonesia.

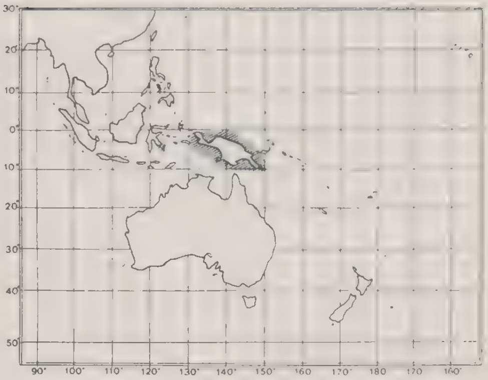
Synonymy : Scyllium malaisianus Lesson, 1824; Chiloscyllium malaianum Müller & Henle, 1839.

FAO Names : En - Indonesian speckled carpetshark; Fr - Requin-chabot grivelé; Sp - Bamboa jaspeada.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, extremely elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, dark wide-spaced spots, a moderately large black spot on flanks above pectoral fins, no black hood.

Diagnostic Features : Body somewhat stouter and snout less swollen and greatly elongated than in H. ocellatum. Colour pattern of scattered large and small dark spots, not close-set and not forming a light reticular pattern with the background colour; head without a dark hood, flanks above pectoral fins with a moderately large black spot, not formed into a conspicuous ocellus; no large white spots on sides; no dark crossbands on ventral surface of tail.



Geographical Distribution : Western South Pacific: Indonesia (Irian Jaya, Waigeo), Papua New Guinea.

Habitat and Biology : A little-known bottom shark, probably common on coral reefs.

Size : To at least 46 cm total length.

Interest to Fisheries : None at present.

Literature : Garman (1913); Fowler (1941).

Hemiscyllium hallstromi Whitley, 1967

HEMIS Hemis 2

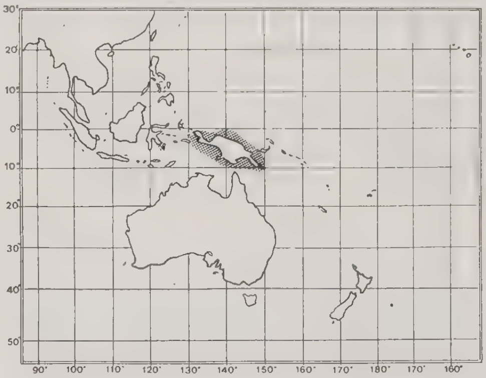
Hemiscyllium hallstromi Whitley, 1967, Aust.Zool., 14(2):178. Holotype: Australian Museum, Sydney. Type Locality: New Guinea

Synonymy : None.

FAO Names : En - Papuan epaulette shark; Fr - Requin-chabot épaulette; Sp - Bamboa hombrera.

Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, extremely elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, dark wide-spaced spots, a conspicuous white-ringed black ocellar spot on flanks above pectoral fins, surrounded by smaller black spots, no black hood.

Diagnostic Features : Colour pattern of scattered large and small dark spots, not close-set and not forming a light reticular pattern with the back ground colour; head without a dark hood, flanks above pectoral fins with a large black spot, ringed with white in the form of a conspicuous ocellus and with a number of surrounding smaller black spots; no large white spots on sides; no dark crossbands on ventral surface of tail.



Geographical Distribution : Western South Pacific: Papua New Guinea, Indonesia (Irian Jaya).

Habitat and Biology : A little-known inshore bottom shark, probably on coral reefs.

Size : To at least 75 cm total length.

Interest to Fisheries : None at present.

Literature : Whitley (1967).

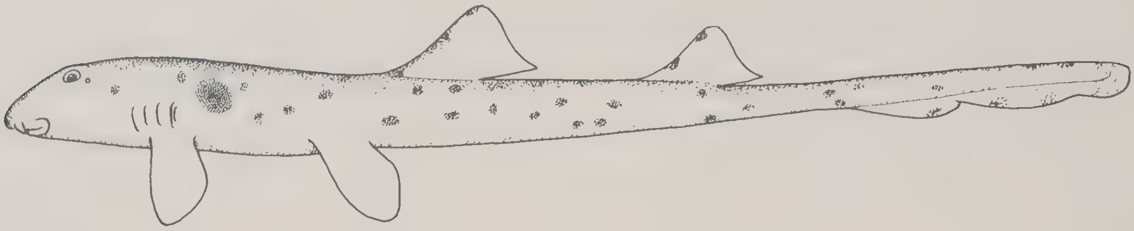
Hemiscyllium ocellatum (Bonnaterre, 1788)

HEMIS Hemis 3

Squalus ocellatus Bonnaterre, 1788, Tabl.encyclop.méthod.trois reg.nat., Ichthyol., Paris, 8. Holotype: Muséum National d'Histoire Naturelle, MNHN 1003, 355 mm male. Type Locality: "La mer du sud".

Synonymy : Squalus oculatus Gray, 1826

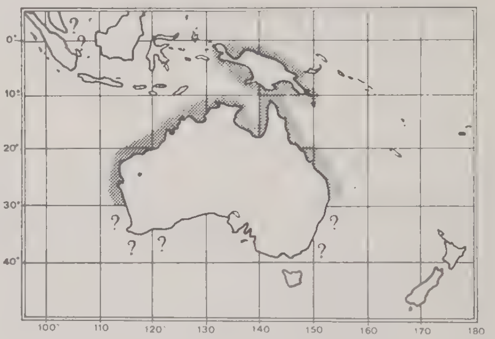
FAO Names : En - Epaulette shark; Fr - Requin-chabot ocellé; Sp - Bamboa ocelada.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, extremely elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, dark wide-spaced spots, a conspicuous large black ocellus, without surrounding black spots, on flanks above pectoral fins, no black hood.

Diagnostic Features : Body slenderer and snout more swollen and elongated than in other species. Colour pattern of scattered large dark spots, not close-set and not forming a light reticular pattern with the background colour; head without a dark hood, flanks above pectoral fins with a very large black spot, ringed with white in the form of a conspicuous ocellus but without surrounding large dark spots; no large white spots on sides; no dark crossbands on ventral surface of tail.

Geographical Distribution : Western South Pacific: New Guinea, Australia (Northern Territory, Western Australia, Queensland, ? New South Wales). Possibly also Malaysia and Sumatra (according to Stead, 1963).



Habitat and Biology : An abundant, small, harmless tropical shark found on coral reefs in shallow water, often in tidepools. Particularly common on the Great Barrier Reef, where it can be seen crawling and clambering about on the bottom. When captured the epaulette shark squirms fitfully but cannot readily escape. Oviparous. Harmless to people.

Size : Maximum total length about 107 cm.

Interest to Fisheries : None at present.

Literature : Garman (1913); Whitley (1940); Fowler (1941); Stead (1963); Marshall (1964); Whitley & Pollard (1980).

Hemiscyllium strahani Whitley, 1967

HEMIS Hemis 4

Hemiscyllium strahani Whitley, 1967, Aust.Zool., 14(2):176, fig. 1. Holotype: Australian Museum, Sydney? Type Locality: New Guinea.

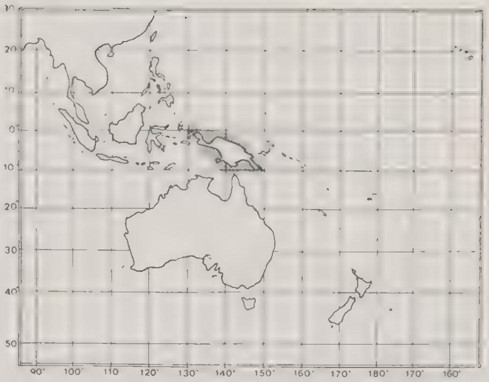
Synonymy : None.

FAO Names : En - Hooded carpetshark; Fr - Requin-chabot moine; Sp - Bamboa capuchona.

Field Marks : Unique black hood on head, also, mouth well in front of eyes, spineless dorsal fins far posterior on tail, extremely elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, white spots on body.

Diagnostic Features : Body stouter, and snout less swollen and elongated than H. ocellatum. Colour pattern with a unique black 'executioner's hood' on head, and scattered large white spots on body, also some small dark spots but no conspicuous ocellus on shoulder region; no dark crossbands on ventral surface of tail.

Geographical Distribution : Western South Pacific: Papua New Guinea, Indonesia (Irian Jaya).



Habitat and Biology : A little-known inshore bottom shark of singular and unique appearance, probably on coral reefs.

Size : To about 75 cm total length.

Interest to Fisheries : None at present.

Literature : Whitley (1967).

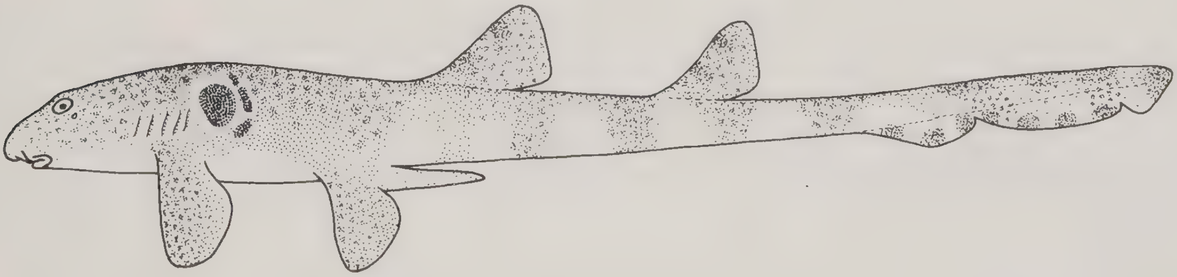
Hemiscyllium trispeculare Richardson, 1843

HEMIS Hemis 5

Hemiscyllium trispeculare Richardson, 1843, Icones Piscium, Pl. Rare Fish:5, pl. 1, fig. 2. Holotype: British Museum, Natural History, 580 mm adult male. Type Locality: Turtle Island, northwestern Australia.

Synonymy : None.

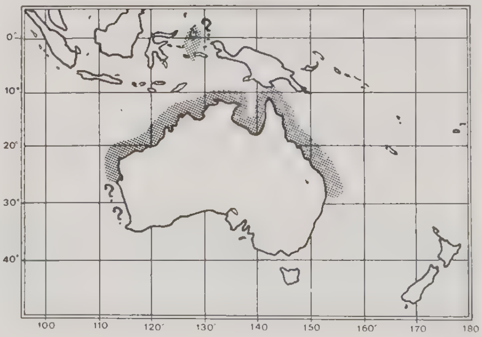
FAO Names : En - Speckled carpetshark; Fr - Requin-chabot marquéterie; Sp - Bamboa moteada.



Field Marks : Mouth well in front of eyes, spineless dorsal fins far posterior on tail, extremely elongated thick precaudal tail, long and low anal fin just anterior to caudal fin, numerous dark close-set spots forming a reticular pattern, a conspicuous white-ringed large black ocellus on flanks above pectoral fins, partly surrounded by smaller black spots, no black hood.

Diagnostic Features : Body stouter and snout less swollen and elongated than *H. ocellatum*. Colour pattern of densely clustered large and small dark spots, forming a light reticular pattern with the background colour; head without a dark hood, flanks above pectoral fins with a large black spot, rimmed with white in the form of a conspicuous ocellus; ocellus partly rimmed posteriorly by a few large black spots; no large white spots on sides; colour pattern of sides of tail continued onto ventral surface in the form of dark crossbands.

Geographical Distribution : Western South Pacific: ? Indonesia (Moluccas), Australia (northern and Western Australia, Queensland).



Habitat and Biology : A common, small, harmless tropical continental shelf shark that is found on coral reefs in shallow water.

Size : Adult males 57 to 64 cm total length, appparently a smaller species than *H. ocellatum*.

Interest to Fisheries : None at present.

Literature : Garman (1913); Fowler (1941); Stead (1963); Whitley & Pollard (1980).

7.5 FAMILY STEGOSTOMATIDAE Gill, 1862

STEG

Subfamily Stegostomatinae Gill, 1862 (Family Scylliorhinoidae), Ann.Lyceum Nat.Hist.N.Y., 7(32):407-8.

Synonymy : None.

FAO Names : En - Zebra sharks; Fr - Requins zèbres; Sp - Tiburones acebrados.

Diagnostic Features : Body cylindrical, with prominent ridges on sides. Head broad conical, and somewhat flattened, without lateral flaps of skin, snout very broadly rounded or truncated; eyes laterally situated on head, without subocular pockets; spiracles subequal in size to eyes but not below them; gill slits small, fifth overlapping fourth; internal gill slits without filter screens; nostrils with short pointed barbels but without circumnarial folds and grooves; mouth moderately large, subterminal on head, and transverse, without a symphyseal groove on chin; teeth not strongly differentiated in jaws, with a medial cusp, lateral cusplets and weak labial root lobes; 28 to 33/22 to 32. Caudal peduncle without lateral keels or precaudal pits. First dorsal larger than second, with origin expanded well ahead of pelvic origins and insertion about over the pelvic bases; pectoral fins rather large, broad and rounded, much larger than pelvic fins, with fin radials partly into fin web but falling well short of its distal edge; pelvic fins smaller than first dorsal but larger than second dorsal and as large or larger than anal fin; anal fin larger than second dorsal, with its origin about opposite second dorsal midbase or insertion; anal fin with broad base and angular apex, separated by a space or narrow notch much less than base length from lower caudal origin; caudal fin with its upper lobe at a low angle above the body axis, about half as long as the entire shark, with a strong terminal lobe and subterminal notch but no ventral lobe. Supraorbital crests present on cranium, these laterally expanded. Valvular intestine of ring type. Colour pattern of dark saddles in young, changing to dark spots in adults.

Interest to Fisheries : See the account of the single species.

Remarks : This family is recognized following the work of Applegate (1974) and Compagno (1973c).

Stegostoma Müller & Henle, 1837

STEG Steg

Genus : Stegostoma Müller & Henle, 1837, Ber.K.Preuss.Akad.Wiss.Berl., 2:112.

Type Species : Squalus fasciatus Bloch & Schneider, 1801, by original designation, equals Squalus fasciatus Hermann, 1783.

Synonymy : Stegostonea Regan, 1929 (error).

Stegostoma fasciatum (Hermann, 1783)

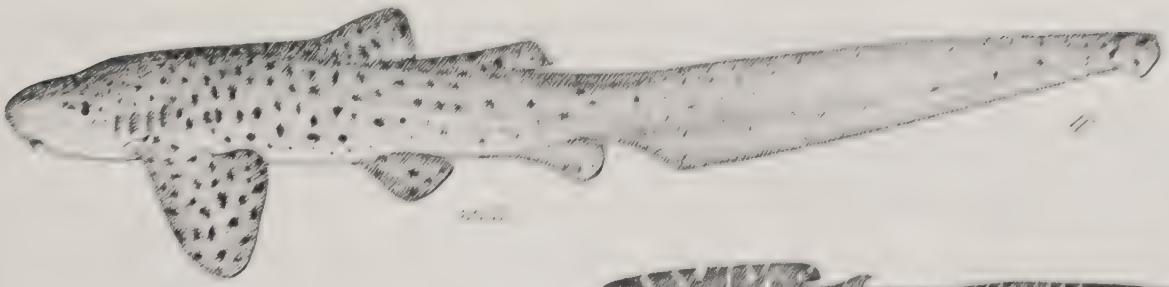
STEG Steg 1

Squalus fasciatus Hermann, 1783, Tabl.Aff., 302 (based on Squalus varius Seba, 1758 or 1761). Holotype: None. Type Locality: Uncertain, probably Indonesia.

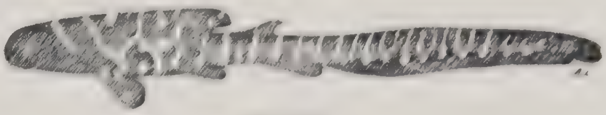
Synonymy : Squalus varius Seba, 1758 (see remarks below); ? Squalus tigrinus Pennant, 1764 (nomen nudum); Squalus tigrinus Bonnaterre, 1788 and Squalus tigrinus Gmelin, 1789; Squalus longicaudus Gmelin, 1789; ? Squalus waddi Bloch & Schneider, 1801; Scyllium quinquecarinatum van Hasselt, 1823; Scyllium heptagonum Rüppell, 1837; Stegostoma carinatum Blyth, 1847; Squalus pantherinus Kuhl & van Hasselt, in Bleeker, 1852 (name only); Squalus cirrosus Gronow, in Gray, 1854; Stegostoma varium Garman, 1913; Stegostoma tigrinum naucum Whitley, 1939.

Other Scientific Names Recently in Use : Stegostoma tigrinum (Gmelin, 1789).

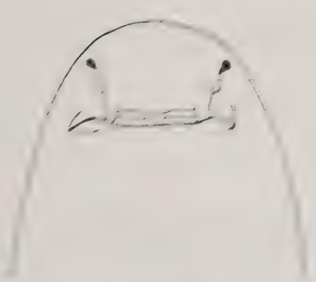
FAO Names : En - Zebra shark; Fr - Requin zèbre; Sp - Tiburón acebrado.



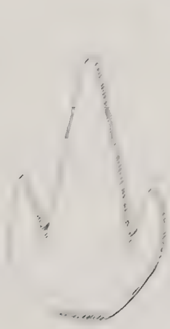
adult



juvenile



underside of head

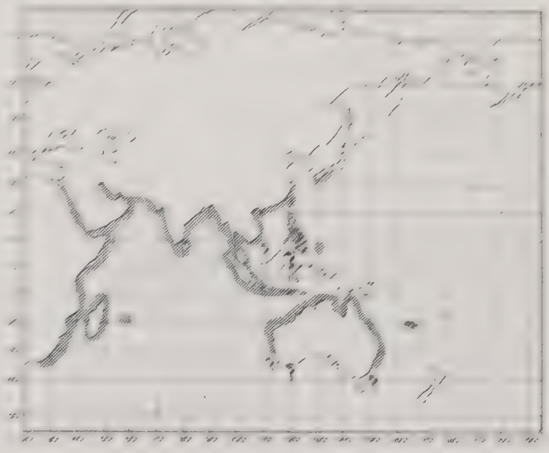


tooth

Field Marks : Unique large sharks that combine a broad, low caudal fin about as long as the rest of the shark with nasoral grooves, barbels, a small transverse mouth in front of the lateral eyes, two spineless dorsal fins and an anal fin, the first dorsal much larger than the second and with its origin far foward on back, prominent ridges on the sides of the body, but no strong lateral keels on the caudal peduncle, and a banded or spotted colour pattern. Young sharks are dark brown above, yellowish below, with vertical yellow stripes and spots breaking the dorsal coloration into dark saddles; between 50 and 90 cm length the saddles break up into small brown spots on a yellow background, these becoming less linear and more uniformly distributed with further increase in size. There is considerable variation in the colour pattern between individuals of like size. An albino specimen was once collected.

Diagnostic Features : See family.

Geographical Distribution : Indo-West Pacific: From South Africa and Red Sea to Pakistan, India, Sri Lanka, Bangladesh, Indonesia, Thailand, Viet Nam, Kampuchea, the Philippines, China, Japan, Australia (Western and Northern Australia, New South Wales), New Caledonia, Palau.



Habitat and Biology : This is a tropical inshore shark, of the continental and insular shelves of the Indo-West Pacific, that is very common on coral reefs. Its behaviour is little known, but it has been photographed resting on sandy areas within reefs, propped up on its pectoral fins and facing a current with open mouth. It apparently is rather sluggish, at least during the daytime, and may be more active at night like nurse sharks (Ginglymostomatidae). Because of its rather slender, flexible body and caudal fin it is able to squirm into narrow cracks, crevices and channel in reefs while searching for food. In captivity, it spends most of its time resting on the bottom (at least during the day), but becomes active when food is introduced into its tank.

Oviparous, laying eggs in large (17 cm long, 8 cm wide and about 5 cm thick), dark brown or purplish-black cases with fine lateral tufts of hairlike fibers, which serve to anchor the cases to the substrate. Probably lays more than one or two eggs at once, as four fully formed, encased eggs were found in one oviduct of an adult female.

Feeds primarily on molluscs (gastropods and bivalves), but also crustaceans (crabs and shrimps) and small bony fishes.

A hardy shark, readily kept in captivity. The zebra shark is unaggressive when approached underwater, and has not been implicated in attacks on people. Although this shark is apparently not dangerous, and has very small teeth, its jaws are strong and could deliver a painful bite to an unwary human tormentor.

Size: Maximum total length possibly 354 cm; males mature between 147 and 183 cm, females between 169 to 171 cm and reaching at least 233 cm; young hatching at a size between 20 and 36 cm.

Interest to Fisheries: A common shark in the Indo-West Pacific, regularly taken in inshore fisheries in Pakistan, India, Thailand, Malaysia, Taiwan (Province of China), and elsewhere where it occurs. It is caught in bottom trawls, in floating and fixed bottom gillnets, and with longlines and other line gear. The meat is utilized fresh and dried salted for human consumption; livers processed for vitamins; fins dried and processed for the oriental sharkfin trade; and offal utilized for fishmeal.

Literature: Garman (1913); Smith (1949); Fowler (1941); Klausewitz (1960); Stead (1963); Gohar & Mazhar (1964); Marshall (1965); Misra (1969); Bass, d'Aubrey & Kistnasamy (1975b); Faulkner (1975); Masuda, Araga & Yoshino (1975); Dingerkus & DeFino (1983).

Remarks: The earliest name for the zebra shark is *Squalus varius* Seba, 1758, which has been used by various writers such as Garman (1913), Klausewitz (1960), and Bass, d'Aubrey & Kistnasamy (1975b) as *Stegostoma varium*. However, an examination of Seba's (1758) descriptions of fishes showed that his nomenclature was haphazardly uninomial, binomial, and polynomial, although the name of the zebra shark could be construed as binomial: [illegible] (Seba, 1758, p. 105).

In addition to the above name-diagnosis, Seba includes a long, accurate, Latin description of the zebra shark, and a longer version in French, and a good illustration of a juvenile zebra shark (Seba, 1758, pl. 34, no. 1). I hesitate to use *Stegostoma varium* as a name for this shark because Seba's nomenclature was not consistently binomial, but note that the International Commission on Zoological Nomenclature may have to rule on its availability.

FAMILY GINGLYMOSTOMATIDAE GILL, 1862

GINGL

Family: Ginglymostomatidae Gill, 1862, Ann. Lyceum Nat. Hist. New York, 7(32):406.

Synonyms: Subfamily Nebriinae Fowler, 1934 (Family Orectolobidae).

FAO Names: En - Nurse sharks; Fr - Requins nourrices; Sp - Gatas nodrizas.

Field Marks: Small to large sharks with nasoral grooves but no perinasal grooves and folds, short to long barbels, small transverse mouths in front of eyes, small spiracles behind but not below eyes, no lateral skin flaps on head, two spineless dorsal fins and an anal fin, the second dorsal origin well ahead of the anal origin, and a short precaudal tail much shorter than the head and body.

Diagnostic Features: Body cylindrical or moderately depressed, without ridges on sides. Head broad and flattened, without lateral flaps of skin; snout truncated or broadly rounded; eyes [illegible] or laterally situated on head, without subocular pockets; spiracles much smaller than eyes, behind but not below them; gill slits small, with [illegible] overlapping fourth; internal gill slits without filter screens. Nostrils with short to moderately long, pointed barbels but without circumnarial folds and grooves. Mouth moderately large, subterminal on head and transverse, without a symphysial groove on chin; teeth not strongly differentiated in jaws, with a medial cusp, lateral cusplets and weak labial root lobes; tooth rows 24 to 38/22 to 32. Caudal peduncle without lateral ridges or precaudal pits. Dorsal fins [illegible] first dorsal larger than second; first dorsal with origin varying from slightly anterior to the pelvic origins to over their bases, and insertion just behind the pelvic insertions; pectoral fins moderately large, broad and rounded to narrow and falcate, larger than pelvic fins, with the radials partially expanded into the web but falling short of its distal edges; pelvic fins somewhat larger to somewhat smaller than dorsals and anal; anal fin about as large as second dorsal, with its origin about opposite second dorsal origin or insertion, anal fin with broad base and angular apex, separated by a space much less than base length from lower caudal origin; caudal fin with its upper lobe at a low angle above the body axis, less than a third as long as the entire shark, with a strong terminal lobe and subterminal notch but no ventral lobe or a very short one. [illegible] Intestinal valve of ring type. Colour [illegible] with or without spots in young.

Habitat, Distribution and Biology: These are common, small to large, nocturnal, inshore bottom sharks with a circumglobal distribution in continental and insular tropical and warm-temperate waters, in depths from the intertidal down to at least 70 m. They frequent coral and rocky reefs, in sandy areas, on reef lagoons, mangrove keys, and in the surf zone, usually close inshore and sometimes in water deep enough only to cover them. At least two of these species occur in groups while resting on the bottom, often lying atop one another. One species (*Ginglymostoma brevicaudatum*) is a small shark attaining a length of less than 1 m, but the others are large, bulky sharks reaching over 3 m.

Development is ovoviviparous in at least one species (*Ginglymostoma cirratum*), with young that are nourished primarily by yolk while in the uterus; litters of 20 to 30 young have been reported. Another species (*Nebrius ferrugineus*) is variously reported as ovoviviparous or oviparous.

These sharks cruise and clamber on the bottom with their mouths and barbels close to the substrate while searching for food; when they contact a food item, they reverse and use their short, small mouths and large mouth cavities as a bellows to suck in their prey. The presence of small, active reef fishes in the stomachs of large, seemingly clumsy nurse sharks suggest that they may stalk and suddenly suck in such items, or alternatively merely inhale them in when the prey fishes are torpid and lying on the bottom at night. Food items include a variety of bottom and reef organisms, bony fishes, crabs, shrimps, lobsters, and other crustaceans, squids, octopuses, and other molluscs, corals, sea urchins and sea squirts. These are very tough and hardy sharks, that can survive over a decade in captivity. The larger species should be treated with respect, as they will bite and clamp on to a human tormentor when provoked; and their vice-like jaws may need to be pried lose from a victim. One species (*Ginglymostoma cirratum*) has been indited in unprovoked attacks on people, but more often will bite when harassed.

Interest to Fisheries : The larger species are common inshore sharks with wide ranges and are often caught in local inshore fisheries. They are utilized for human consumption, for liver oil, and for their thick and exceptionally tough hides, which make extremely good leather.

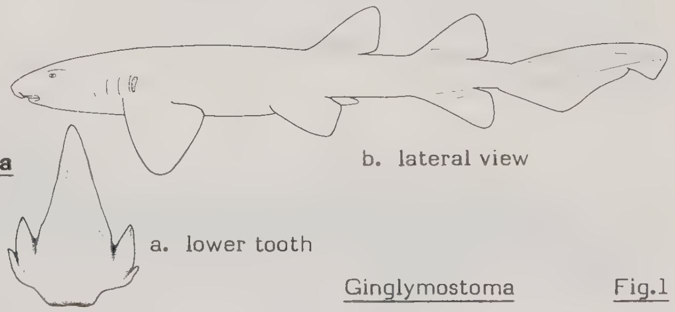
Remarks : This family is recognized following the works of Compagno (1973c, 1982) and Applegate (1974). The genus *Nebrius* is sometimes considered a subgenus of *Ginglymostoma* as by Fowler (1941), but following Garman (1913), Whitley (1940), Bigelow & Schroeder (1948), Garrick & Schultz (1963), Applegate (1974), and Bass, d'Aubrey & Kistnasamy (1975b), it is accorded full generic status. *Nebrius* and *Ginglymostoma* are usually distinguished by tooth structural characters. According to Bigelow & Schroeder (1948), *Ginglymostoma* has teeth with the "central cusp" largest and with several series functional, while *Nebrius* has teeth with "all cusps equal" (cusps as large as cusplets) and with only one or two series functional. However, *Nebrius* material examined varied considerably in cusp size, but in no instance had the cusps only as large as the cusplets (cusps were smallest in young sharks, largest in adults); number of series functional ranged from 2 to 3 in *Nebrius* specimens but overlapped *Ginglymostoma cirratum* with 3 to 4. Hence the arrangement and definition of these genera are modified, and the two are distinguished by fin shape and tooth arrangement characters.

The small *Ginglymostoma brevicaudatum* is strongly divergent morphologically from *G. cirratum*, which is closer to *Nebrius ferrugineus*. Although *G. brevicaudatum* is clearly a ginglymostomatid, it differs from the other two species in having orthodont tooth structure, much smaller cusplets, larger cusps and narrower crowns on its teeth, smaller barbels, more posterior first dorsal origin, equal-sized dorsal fins, a shorter caudal fin, as well as cranial differences. This suggests that *G. brevicaudatum* may be generically distinct from *Ginglymostoma* proper, and may be referable to the fossil tooth genus *Eostegostoma* Herman & Crochard, 1977. *G. cirratum* is clearly intermediate between the more primitive *G. brevicaudatum* and the more derived *N. ferrugineus*. In cladistic terms, *G. cirratum* and *N. ferrugineus* are sister species, with *G. brevicaudatum* their primitive sister.

Key to Genera :

1a Teeth not compressed in sides of jaw, not imbricated (Fig. 1a). Pectoral, dorsal and anal fins apically rounded, pectoral fins broad and not falcate (Fig. 1b) .... ***Ginglymostoma***

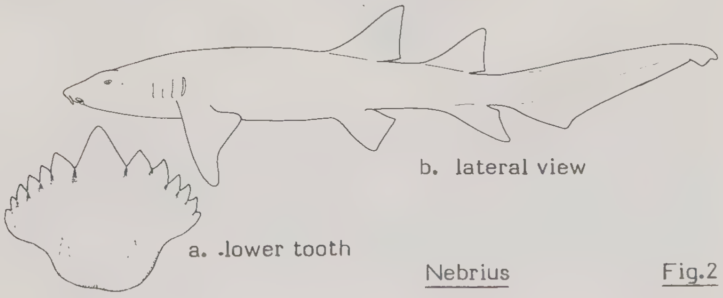
1b. Teeth more or less compressed in sides of jaws, forming imbricated series (Fig. 2a). Pectoral, dorsal and anal fins apically angular, pectoral fins narrow and falcate (Fig. 2b) .... ***Nebrius***



b. lateral view

a. lower tooth

Ginglymostoma Fig.1



b. lateral view

a. lower tooth

Nebrius Fig.2

Ginglymostoma Müller & Henle, 1837

GINGL Gingl

Genus : Ginglymostoma Müller & Henle, 1837, Ber.K.Preuss.Akad.Wiss.Berl., 2:113 (no species mentioned).

Type Species : Squalus cirratus Gmelin, 1789, by subsequent designation of Joredan & Gilbert (1883:18), equals S. cirratus Bonnaterre, 1788.

Synonymy : Ginglimostoma Agassiz, 1838 (error); Gynglimostoma Dumeril, 1859 (error); Gingylostoma Springer, 1939 (error).

Diagnostic Features : Teeth not compressed in sides of jaw, not imbricated. Pectoral, dorsal and anal fins apically rounded, pectoral fins broad and not falcate.

Remarks : Ginglymostoma brevicaudatum may not be congeneric with G. cirratum and is possibly referrable to the genus Eostegostoma Herman & Crochard, 1977 (based on fossil teeth). In addition to G. brevicaudatum and G. cirratum, Scyllium ferrugineum Lesson, 1830 is often included in this genus, but is here included in Nebrius.

Bigelow & Schroeder (1948) stated that Ginglymostoma differed from Nebrius by having teeth with the "central cusp largest" and several "rows" functional, while Nebrius had teeth with "all cusps about equal" and with only one or two "rows" functional. However, representative Nebrius material shows overlap with Ginglymostoma by having teeth also with the "central cusp largest" and in having two or three "rows" (series) functional (vs. 3 or 4 in G. cirratum). Ginglymostoma as here restricted includes species with rounded fins and non-imbricated tooth series, while Nebrius includes species with angular fins and imbricated tooth series (N. ferrugineum and its possible synonym N. concolor).

Key to Species :

1a. Second dorsal and anal fins about as large as first dorsal. Caudal fin short, less than 1/4 of total length .... **G. brevicaudatum**

1b. Second dorsal and anal fins much smaller than first dorsal. Caudal fin longer, over 1/4 of total length .... **G. cirratum**

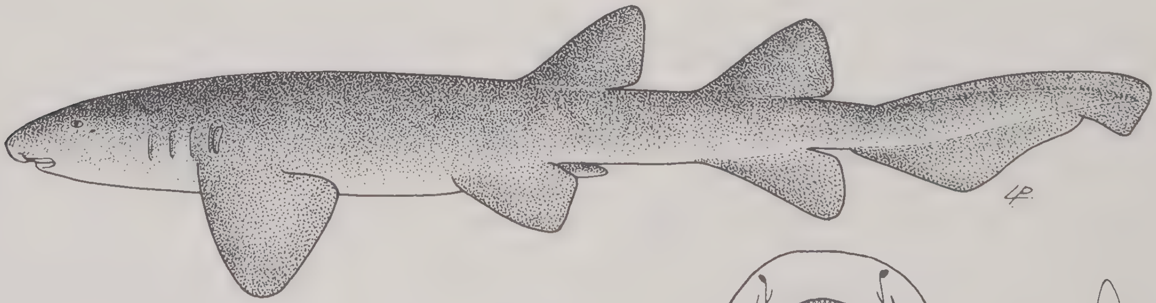
Ginglymostoma brevicaudatum Günther, 1866

GINGL Gingl 2

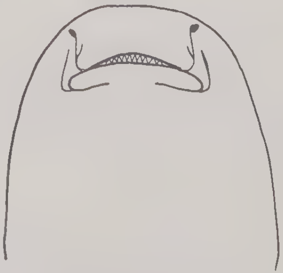
Ginglymostoma brevicaudatum Günther, in Playfair & Günther, 1866, Fish.Zanzibar, London, 141, pl. 21. Holotype: British Museum (Natural History), BMNH-1867.3.9.423, stuffed dried adolescent male about 590 mm long; length in original account 640 mm. Type Locality: Zanzibar.

Synonymy : None.

FAO Names : En - Short-tail nurse shark; Fr - Requin-nourrice à queue courte; Sp - Gata nodriza rabicorta.



Field Marks : Very short barbels, nasoral grooves present but no perinasal grooves, mouth well in front of eyes, spiracles minute, precaudal tail shorter than head and body, two spineless, broadly rounded, equal-sized dorsal fins and an equally large anal fin, caudal fin short, less than 1/4 of total length, colour dark brown, without spots or other markings.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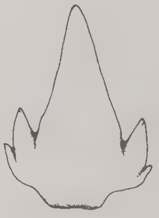
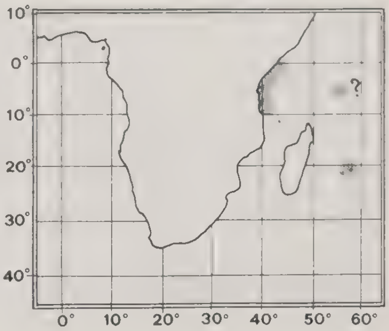

tooth

Diagnostic Features : Nasal barbels very short, not reaching mouth; tooth crowns very narrow, cusps large and cusplets very small. Origin of first dorsal fin about over pelvic insertions; second dorsal and anal fins about as large as first dorsal; caudal fin short, less than 1/4 of total length.

Geographical Distribution : Western Indian Ocean: Tanzania, Kenya, and possibly Mauritius and the Seychelles.



Habitat and Biology : An apparently common but little known inshore bottom shark of the continental and insular shelves of East Africa. Its breeding and feeding habits are unknown.

Size : Maximum total length about 75 cm; adult males 59 to 75 cm.

Interest to Fisheries : Probably limited, possibly fished locally in artisanal fisheries. Hide exceptionally tough, as in *G. cirratum*, and possibly of use for leather.

Literature : Fowler (1941); Bass, d'Aubrey & Kistnasamy (1975b).

Remarks : The writer examined the holotype in the British Museum (Natural History) and five other specimens in the collections of the J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa.

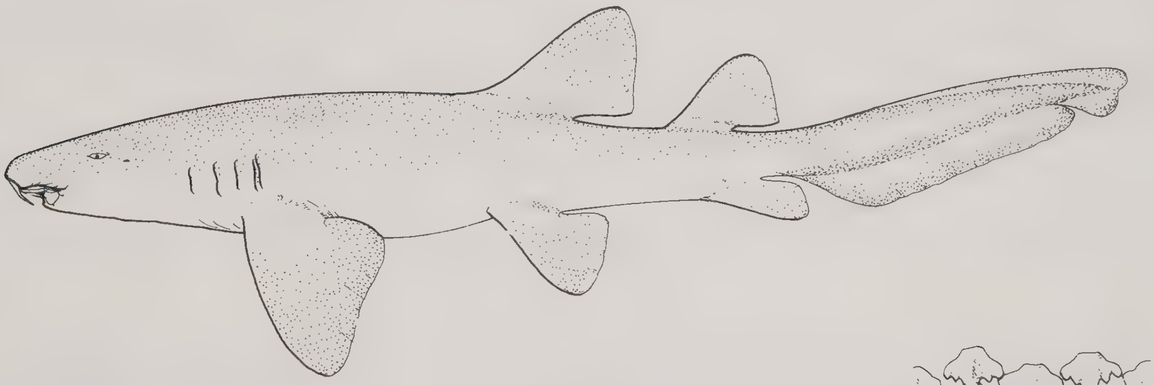
Ginglymostoma cirratum (Bonnaterre, 1788)

GINGL Gingl 1

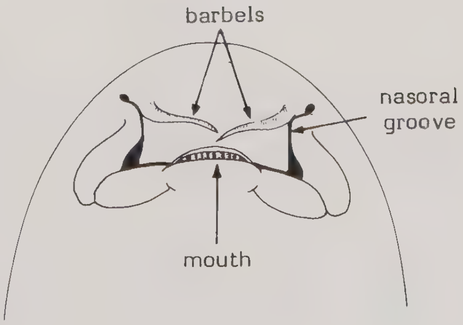
Squalus cirratus Bonnaterre, 1788, Tabl.encyclop.méthod.trois reg.nat., *Ichthyol., Paris*, 7. Lectotype: Muséum National d'Histoire Naturelle, Paris, MNHN A.7654, 458 mm female, locality uncertain. Type Locality: American seas.

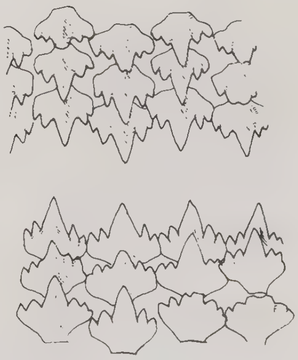
Synonymy : *Squalus punctulatus* Lacepède, 1800; *Squalus punctatus* Bloch & Schneider, 1801; *Squalus argus* Bancroft, 1835; *Ginglymostoma fulvum* Poey, 1861; *Ginglymostoma caboverdianus* Capello, 1867.

FAO Names : En - Nurse shark; Fr - Requin nourrice; Sp - Gata nodriza.



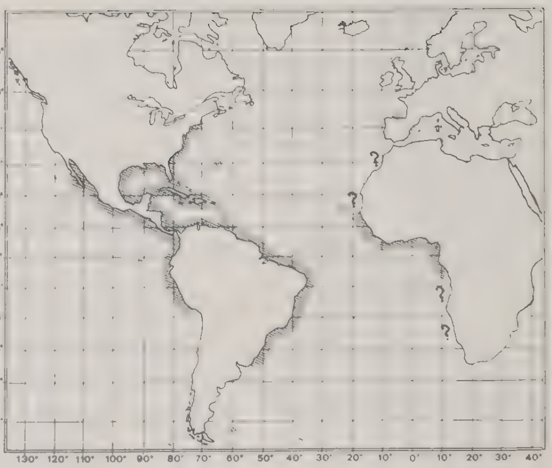
Field Marks : Moderately long barbels, nasoral grooves present but no perinasal grooves, mouth well in front of eyes, spiracles minute, precaudal tail shorter than head and body, two spineless, broadly rounded, dorsal fins and an anal fin, first dorsal fin much larger than second dorsal and anal fins, caudal fin moderately long, over 1/4 of total length, colour yellow-brown to grey-brown, with or without small dark spots and obscure dorsal saddle markings.





upper and lower teeth

Diagnostic Features : Nasal barbels moderately long, reaching mouth; tooth crowns rather broad, cusps small and short and cusplets numerous and large. Origin of first dorsal fin about over pelvic origins; first dorsal fin larger than second dorsal and anal fins; caudal fin moderately long, over 1/4 of total length.



Geographical Distribution : Western Atlantic: Rhode Island to southern Brazil, including Gulf of Mexico, Bermuda, Bahamas, Cuba, Jamaica, Caribbean. Eastern Atlantic: Cape Verde Islands, Senegal, Cameroon to Gabon, and accidental to Gulf of Gascony, France. Eastern Pacific: Southern Baja California, Gulf of California to Peru.

Habitat and Biology : A common large inshore bottom shark of the continental and insular shelves in tropical and subtropical waters, often occurring at depths of a metre or less in the intertidal, but down to at least 12 m. The nurse shark is often found on rocky reefs, in channels between mangrove keys and on sand flats. This is a nocturnal shark that is proverbially sluggish during the daytime but strong-swimming and active at night; it rests on sandy bottom or in caves and crevices in rocks in shallow water during the day, often in schools or aggregates of 3 to three dozen individuals that are close to or even piled on one another while resting. In addition to swimming near the bottom or well off it, the nurse shark can clamber on the bottom using its flexible, muscular pectoral fins as limbs. Preliminary studies indicate that the nurse shark shows a strong preference for certain day resting sites, and repeatedly homes back to the same caves and crevices after a night's activity.

Courtship and copulatory behaviour has been observed, and is apparently rather complex. A pair or sometimes a triplet of adults engage in synchronized parallel swimming, with the male abreast or slightly behind and below the female, but with sides nearly touching. A pair may rest on the bottom on their bellies in parallel after bouts of parallel swimming. While parallel-swimming, the male may grab one of the female's pectoral fins with his mouth, which in turn may induce the female to pivot 90 degrees and roll on her back on the bottom. The male then nudges the female into a position parallel to him, swims on top of the female in parallel, inserts a single clasper in her vent, and then rolls on his back to lie motionless besides the inverted female with clasper still inserted.

Reproduction is ovoviviparous, with intrauterine development of young being sustained primarily by the large supply of yolk in their yolk-sacs. Young are common in late spring and summer in waters off Florida, when females give birth. Numbers of intrauterine eggs or young are 21 to 28 in a litter.

The nurse shark feeds heavily on bottom invertebrates such as spiny lobsters, shrimps, crabs, sea urchins, squids, octopuses, marine snails and bivalves, and also fishes including sea catfishes, mullets, puffers and stingrays. Algae is occasionally found in its stomach. Its small mouth and large, bellows-like pharynx allow it to suck in food items at high speed. This powerful suction feeding mechanism and its nocturnal activity pattern may allow the nurse shark to take small, active prey like fishes that are resting at night but would be too active for this big, lumbering shark to capture in the daytime. When dealing with big, heavy-shelled conchs the nurse shark flips them over and extracts the snail from its shell, presumably with its teeth and by suction.

Young nurse sharks have been observed resting with their snouts pointed upward and their bodies supported off the bottom on their pectoral fins; this has been interpreted as possibly providing a false shelter for crabs and small fishes that the shark then ambushes and eats. In captivity the nurse shark, when stimulated by food in the form of cut fish, will cruise in circles close to the bottom searching for the food, with its barbels touching or nearly touching the bottom; when it contacts a chunk of food, it may overshoot it but then quickly backs up and rapidly inhales it in. It may even work over vertical surfaces with its barbels.

The nurse shark is often regarded as harmless to people, because of its sluggishness during the day and relatively small teeth. In the Caribbean and off Florida people frequently come in contact with it, and it mostly will not react aggressively when approached but usually swims away when disturbed. However, there have been a small number of non-fatal, unprovoked attacks on swimmers and divers with uncertain motivation on the part of the sharks, though non-feeding aggression or some other motivation is more likely than feeding attacks because of the relatively small prey taken by this shark. In one bizarre unprovoked attack a large nurse shark grabbed a diver's chest with its teeth, then appeared to hold onto his body with its pectoral fins; unfortunately the sex of the shark was not recorded. More commonly people attempt to ride, spear, brag or otherwise harass this shark, or accidentally step on one while wading, and get bitten as a result. Although its teeth are small, the jaws and associated muscles of the nurse shark are extremely powerful and vice-like; in some instances nurse sharks have bitten people and held on, and had to be pried loose with a tool.

These sharks are very hardy and capable of surviving a wide range of temperatures and dissolved oxygen levels in captivity. They grow to adult size when obtained as young and kept in aquaria of sufficient size, and will even give birth in captivity. Specimens have been kept for 24 to 25 years. The young make interesting pets and can be trained to feed at the surface. These sharks have often been used for experimental behavioural and physiological research in captivity, for which they are excellent subjects because of their hardiness and ability to learn.

Size : Maximum total length said to be 430 cm but most adults are under 3 m long and the largest otherwise reported were 280 to 304 cm; adults males mature at about 225 cm and reach at least 257 cm; females are immature at 225 to 235 cm and mostly mature at about 230 to 240 cm (though one 152 cm long has been reported) and reach over 259 cm; newborn young about 27 to 30 cm.

Interest to Fisheries : Very common in shallow waters where it occurs, and often captured in local artisanal fisheries. It has been prized for its extremely tough, thick, armor-like hide, which makes an exceptionally good leather, but is also used fresh and salted for human consumption, as well as for liver oil and fishmeal. The stratoconidia (earstones) of this shark and other species are said to be used as a diuretic by local fishermen in southern Brazil. It is captured with line gear, gillnets, fixed bottom nets and bottom trawls, and spears. It can be readily captured on sportfishing tackle, but is regarded as too sluggish to be much of a game fish. Divers sometimes spear nurse sharks, which is minimal sport because of their modest speed even when active; but the toughness of these sharks may make then difficult to subdue underwater. In the Lesser Antilles, the nurse shark is regarded as a pest by fishermen because it rifles fish traps for food.

Literature : Bigelow & Schroeder (1948); Cadenat (1957); Randall (1961, 1963); Clark (1963); Garrick & Schultz (1963); Limbaugh (1963); Springer (1963); Clark & von Schmidt (1965); Klimley (1974, 1980); Cadenat & Blache (1981).

Nebrius Rüppell, 1837

GINGL Neb

Genus : *Nebrius* Rüppell, 1837, *Neue Wirbel.Faun.Abyssinien, Fische Rothen Meeres*, (11):62, pl. 17, fig. 2.

Type Species : *Nebrius concolor* Rüppell, 1837, by monotypy, apparently equals *Scyllium ferrugineum* Lesson, 1830.

Synonymy : Genus *Nebrodes* Garman, 1913 (replacement for *Nebrius* Rüppell, 1837, thought by Garman to be preoccupied by *Nebria* Latreille, 1802 in Insecta and *Nebris* Cuvier & Valenciennes, 1830 in Osteichthyes; however, according to the current Code of Zoological Nomenclature these three names are not homonyms as they differ from each other by at least one letter).

Diagnostic Features : Teeth more or less compressed in sides of jaws, forming imbricated series. Dorsal, pectoral, and anal fins apically angular, pectoral fins narrow and falcate.

Remarks : The genus *Nebrius* is sometimes considered a subgenus of *Ginglymostoma*, but, following Garman (1913), Bigelow & Schroeder (1948), Garrick & Schultz (1963), Applegate (1974), and Bass, d'Aubrey & Kistnasamy (1975b), it is accorded full generic status.

Nebrius ferrugineus (Lesson, 1830)

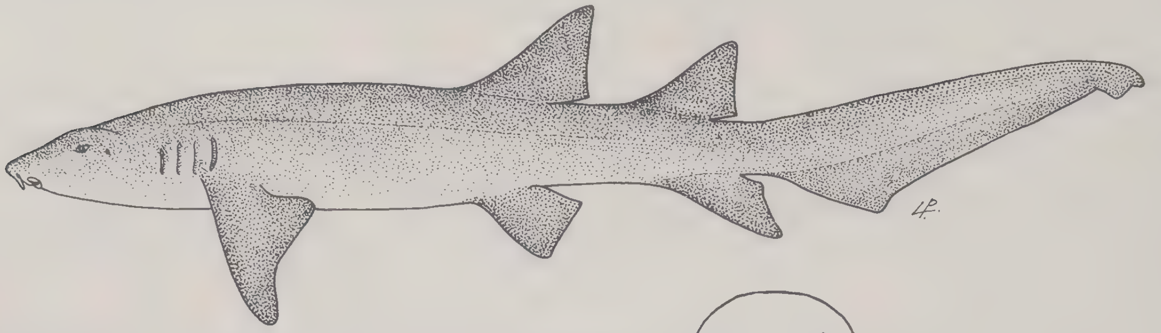
GINGL Neb 1

Scyllium ferrugineum Lesson, 1830, Voy.aut.monde corv."La Coquille2, 1822-1825, Zoologie, 2(1):95. Holotype: ?. Type Locality: ? Mentioned as occurring at New Ireland and Waigiou, south Pacific.

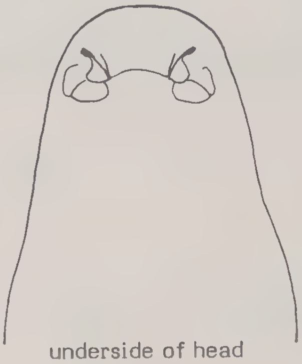
Synonymy : *Nebrius concolor* Rüppell, 1837; *Ginglymostoma rueppellii* Bleeker, 1852; *Ginglymostoma muelleri* Günther, 1870; *Scymnus porosus* Hemprich & Ehrenberg, 1899; *Nebrodes macrurus* Garman, 1913; *Nebrodes concolor ogilbyi* Whitley, 1934; *Nebrius doldi* Smith, 1953.

Other Scientific Names Recently in Use : *Ginglymostoma ferrugineum* (Lesson, 1830).

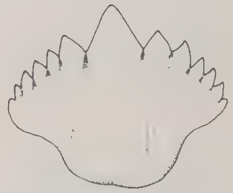
FAO Names : En - Tawny nurse shark; Fr - Requin nourrice fauve; Sp - Gata nodriza atezada.



Field Marks : Moderately long barbels, nasoral grooves present but no perinasal grooves, mouth well in front of eyes, eyes lateral, spiracles minute, precaudal tail shorter than head and body, two spineless, angular dorsal fins and an anal fin, first dorsal fin much larger than second dorsal and anal fins, first dorsal base over pelvic bases, pectoral fins falcate, caudal fin moderately long, over 1/4 of total length, colour brown, from tan to dark grey-brown according to habitat, and slowly changeable by the individual.



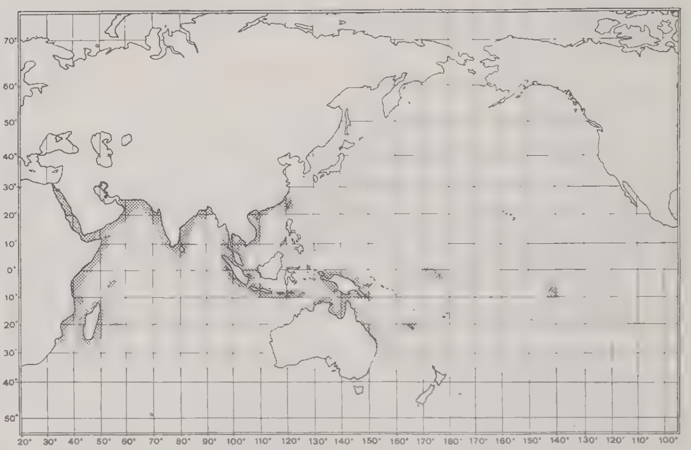
underside of head



tooth

Diagnostic Features : See genus.

Geographical Distribution : Indo-West and Central Pacific: South Africa, Mauritius, Seychelles and Madagascar to Red Sea, India, Malaysia, Indonesia, Singapore, Thailand, Viet Nam, China, Papua New Guinea, Australia (Queensland), New Caledonia, New Ireland, Samoa, Palau, Marshall Islands, Tahiti.



Habitat and Biology : A large, tropical inshore shark of the continental and insular shelves, commonly in the intertidal in water scarcely able to cover it and from the surf line down to a few metres depth, but ranging down to at least 70 m. It occurs on or near the bottom in lagoons or along the outer edges of coral and rocky reefs, sandy areas near reefs and off sandy beaches. It prefers sheltered areas in crevices and caves on reefs but often occurs in more exposed areas in a depression or crevice. The tawny shark is primarily nocturnal, resting in the daytime in shelters but prowling slowly about around reefs at night, although a few individuals may be active in the day. They are gregarious and form resting aggregations of two to a half-dozen or more in shelters, and are often seen piled inertly across or on top of one another. When resting, they are extremely sluggish.

Reproduction ovoviviparous, described as an oviparous or post-oviparous shark that retains the egg-cases until they hatch and the young are born. Number of young at least four per uterus.

Food of this shark includes corals, crabs, lobsters and other crustaceans, octopuses, squids and probably other cephalopods, sea urchins, and reef fishes (including surgeonfishes and siganids). While foraging the tawny shark moves along the bottom and explores depressions, holes and crevices in reefs. When it detects prey it places its small mouth very close to the victim, and uses its large pharynx as a powerful suction pump to rapidly inhale in reef organisms that may be out of reach of its teeth. A few large individuals dissected by the writer had quantities of small, active reef fishes in their stomachs, presumably sucked in by the sharks as the prey fishes lay inert in shelters or on the bottom at night. Individuals caught by fishermen may reverse this sucking action, and blast streams of water out of their mouths into the faces of their captors; they are said to make a grunting sound between streams.

This has been described as a much more docile species than its close relative, Ginglymostoma cirratum, and apparently usually allows humans to touch and play with it without biting. However, there are a few non-fatal attack records of these sharks biting their tormentors, and clamping tightly onto them. Because of its size and strength, the tawny shark should be regarded as potentially dangerous and treated with respect.

This is a tough, hardy shark that readily survives in captivity.

Size : Maximum total length about 314 to 320 cm; though most individuals are smaller; an adult male was 250 cm long and two adults females, from 230 to 290 cm; size at birth about 40 cm.

Interest to Fisheries : Common in areas where it occurs, and caught inshore by fishermen in Pakistan, India, and Thailand, and probably elsewhere. It is utilized fresh and dried salted for human food, its liver is rendered for oil and vitamins, its fins are used in the oriental sharkfin trade, and offal is processed into fishmeal. Its thick, armor-like hide is potentially valuable for leather. Off Queensland, Australia, it has been fished as a big-game shark, and large individuals are prized as powerful fighters.

Literature : Fowler (1941); Gohar & Mazhar (1964); Marshall (1965); Bass, d'Aubrey & Kistnasamy (1975b); Fourmanoir & Laboute (1976); Johnson (1978); Randall (1980).

Remarks : I tentatively include Nebrius concolor and its synonyms in synonymy of N. ferrugineus. Normally these species are retained and often placed in different genera, with N. ferrugineus being usually placed in Ginglymostoma and concolor in Nebrius. However, the dentitional differences used to separate the two species (as in Garman, 1913, and Fowler, 1941: more compressed, more low-cusped teeth in concolor and less compressed, more high-cusped teeth in ferrugineus) may be due to growth changes in the teeth of a single species (ontogenetic heterodonty). At least in the material of Nebrius examined from the Gulf of Thailand and elsewhere, larger specimens over 2 m long have teeth of the ferrugineus type, while specimens about a meter long or less have teeth of the concolor type. Teeth of a specimen 1.8 m long pictured by Bass, d'Aubrey & Kistnasamy (1975b) are roughly intermediate. Growth changes apparently include increase in size of cusps relative to cusplets, shortening and broadening of the labial flange, and thickening and broadening of the teeth relative to their height.

7.7 FAMILY RHINIODONTIDAE Müller & Henle, 1839, amended

RHIN

Rhinodontes Müller & Henle, 1839, Syst.Beschr.Plagiost., pt. 2:77.

Synonymy : None.

FAO Names : En - Whale sharks; Fr - Requins baleine; Sp - Tiburones ballena.

Diagnostic Features : Body cylindrical or moderately depressed, with prominent ridges on sides. Head very broad and flattened, without lateral flaps of skin, snout truncated; eyes laterally situated on head, without subocular pockets; spiracles much smaller than eyes, behind but not below them; gill slits very large, fifth well separated from fourth; internal gill slits with unique filter screens, consisting of transverse lamellae that cross each gill slit, with ramose processes on their inner surfaces that interconnect to form the filters; nostrils with rudimentary barbels and no circumnarial folds and grooves; mouth extremely large, terminal on head, and transverse, without a symphyseal groove on chin; teeth not strongly differentiated in jaws, with a medial cusp, no cusplets and no labial root lobes; tooth rows extremely numerous, in over 300 rows in either jaw of adults and subadults. Caudal peduncle with strong lateral keels and an upper precaudal pit. First dorsal much larger than second, first dorsal with origin well anterior to the pelvic origins, and insertion over the pelvic bases; pectoral fins very large, relatively narrow and falcate, much larger than pelvic fins, with fin radials expanded into fin web nearly to its distal edge; pelvic fins somewhat smaller than first dorsal but slightly larger than second dorsal and anal fins; anal fin about as large as second dorsal, with its origin about opposite first third of second dorsal base; anal fin with broad base and angular apex, separated by a space somewhat greater than base length from lower caudal origin; caudal fin with its upper lobe at a high angle above the body axis, less than a third as long as the entire shark, with a vestigial terminal lobe and subterminal notch and a very strong ventral lobe or a very short one. Supraorbital crests present on cranium, these laterally expanded. Valvular intestine probably of ring type. A unique colour pattern of light spots and vertical and horizontal stripes, in the form of a checkerboard.

Interest to Fisheries : See the account of the single species.

Remarks : The spelling Rhiodontidae, is an amended version of Rhinodontes Müller & Henle, 1839 first mentioned in Compagno (1973c).

Rhiniodon Smith, 1828

RHIN Rhin

Genus : Rhiniodon Smith, 1828, S.African Comm.Advertiser, 3(145):2.

Type Species : Rhiniodon typus Smith, 1828, by original designation (use of the species name typus).

Synonymy : Genus *Rhincodon* Smith, 1829; Genus *Rhinchodon* Smith, 1829; Genus *Rhineodon* Müller & Henle, 1838; Genus *Rineodon* Müller & Henle, 1838; Genus *Rhinodon* Müller & Henle, 1839; Genus *Rhinecodon* Agassiz, 1845; Genus *Micristodus* Gill, 1865.

Remarks : There has been considerable variation in spelling of the generic name of the whale shark, and much usage of several of the variants. Although *Rhiniodon* has priority, the variants *Rhincodon* and *Rhineodon* (and to a lesser extent *Rhinodon*) have had much more usage. Following Bigelow & Schroeder (1948) the variant *Rhincodon* has developed a considerable 'public', and proposals to stabilize it (Robins & Lea, 1975; Swift, 1977) have been presented to the International Commission on Zoological Nomenclature. In contrast Hubbs, Iwai & Matsubara (1975) proposed that the earliest spelling, *Rhiniodon* should be preserved for the whale shark because of priority, more correct orthography than *Rhincodon*, and because the use of *Rhincodon* has not been universal since Bigelow & Schroeder's work. At present the International Commission has yet to hand down a ruling on the matter and, until it does, I prefer to use the earliest spelling (*Rhiniodon*).

Rhiniodon typus Smith, 1828

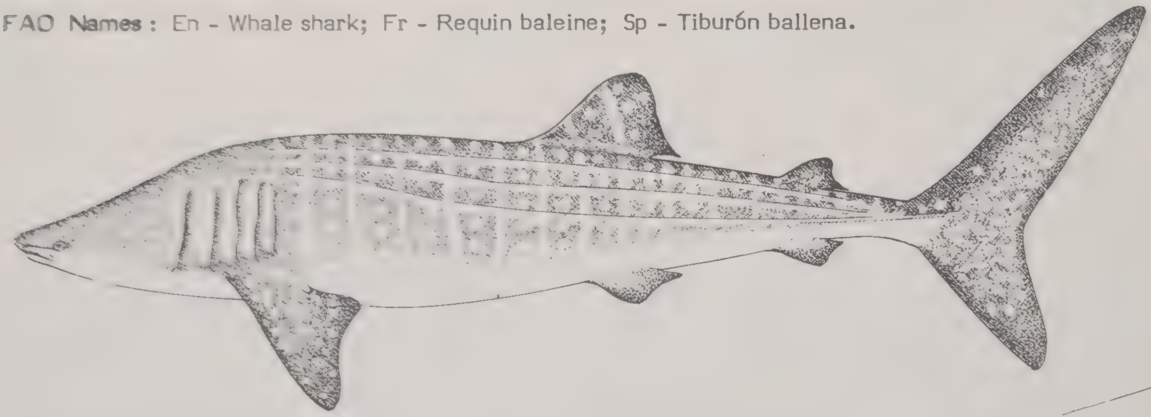
RHIN Rhin 1

Rhiniodon typus Smith, 1828, *S.African Comm.Advertiser*, 3(145):2. Holotype: Muséum National d'Histoire Naturelle, Paris, MNHN 9855, 4600 mm male; mousted, stuffed specimen. Type Locality: Table Bay, South Africa.

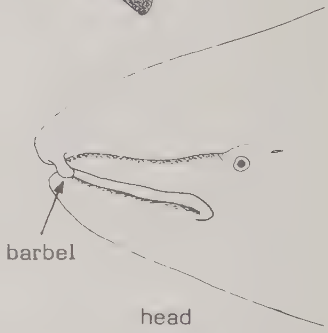
Synonymy : *Rhinodon typicus* Müller & Henle, 1839; *Micristodus punctatus* Gill, 1865; *Rhinodon pentalineatus* Kishinouye, 1891.

Other Scientific Names Recently in Use : *Rhincodon typus* Smith, 1829; *Rhineodon typus* Smith, 1829.

FAO Names : En - Whale shark; Fr - Requin baleine; Sp - Tiburón ballena.

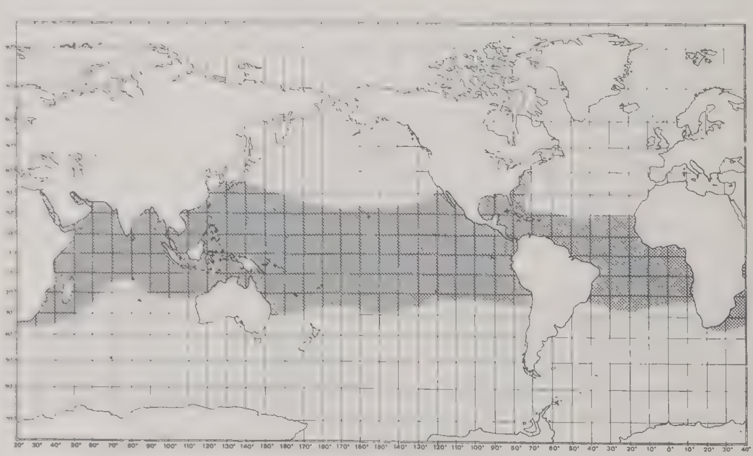


Field Marks : An unmistakable huge shark, one of three large filter-feeding species, with a broad, flat head and truncated snout, immense transverse, virtually terminal mouth in front of eyes, minute, extremely numerous teeth, and unique filter screens on its internal gill slits, prominent ridges on sides of body with the lowermost one expanding into a prominent keel on each side of the caudal peduncle, a large first dorsal and small second dorsal and anal fin, lunate or semilunate caudal fin without a prominent subterminal notch, and a unique checkerboard pattern of light spots, horizontal and vertical stripes on a dark background.



Diagnostic Features : See family.

Geographical Distribution : Circumglobal in tropical and warm temperate seas, oceanic and coastal. Western Atlantic: New York to central Brazil and including Gulf of Mexico and Caribbean. Eastern Atlantic: Senegal, Mauritania, Cape Verde Islands, Gulf of Guinea. Indo-West and central Pacific: South Africa and Red Sea to Pakistan, India, Sri Lanka, Malaysia, Thailand, China, Japan, Philippines, Indonesia (Kalimantan, Java, Irian Jaya), Papua New Guinea, Australia (Queensland, Northern Territory), New Caledonia, Hawaiian Islands. Eastern Pacific: Southern California, to northern Chile.



Habitat and Biology : An epipelagic oceanic and coastal, tropical and warm-temperate pelagic shark, often seen far offshore but coming close inshore and sometimes entering lagoons of coral atolls. It is generally seen or otherwise encountered close to or at the surface, as single individuals or in schools or aggregations of up to hundreds of sharks. In the Indian Ocean it is common around the Seychelles, Mauritius, Zanzibar, Madagascar, Mozambique and northernmost Natal. In the western Pacific it is common in the Kuroshio current in the fishing grounds for skipjack. It is reportedly abundant from Cabo San Lucas to Acapulco in the eastern Pacific, and in the Gulf of Mexico and the Caribbean in the western Atlantic. It apparently prefers areas where the surface temperature is 21 to $25^{o}C$ with cold water of $17^{o}C$ or less upwelling into it, and salinity of 34 to 34.5 ppt; these conditions are probably optimal for production of plankton and small nektonic organisms, all of which are prey of the whale shark. Whale sharks are apparently highly migratory, with their movements probably timed with blooms of planktonic organisms and changes in temperatures of water masses. They are often associated with schools of pelagic fishes, especially scombrids.

Development uncertain, possibly oviparous or ovoviviparous. In 1953 a large eggcase, 30 cm long, 14 cm wide and 9 cm thick containing a nearly full-term 36 cm embryo whale shark was collected from the Gulf of Mexico, and the assumption was made that the species is oviparous (cf. Baughman, 1955, Garrick, 1964, Bass, d'Aubrey & Kistnasamy (1975c). However, the rarity of 'free-living' whale-shark eggs, the extreme thinness and lack of tendrils on the only known case, the considerable yolk and partially developed gill sieve in the only known embryo, and the presence of umbilical scars on larger free living specimens 55 cm long suggests an alternative explanation (Wolfson, 1983), that the Gulf of Mexico egg was aborted before term, and that the whale shark is ovoviviparous. The type of ovoviviparity practiced by the whale shark would be a relatively simple sort very similar to that of the related nurse sharks (Ginglymostomatidae), with retention of the egg case in utero until the embryo hatches. Alternatively, the egg cases of the whale shark might be retained in utero for most of the development of their embryos, then ejected at a late stage of development. Hence the mode of reproduction of the whale shark must be considered uncertain, with ginglymostomatid-like ovoviviparity a distinct possibility. The smallest free-living whale sharks are from 55 to 56 cm long, the smallest of which has an umbilical scar (properly vitelline scar). One adult female whale shark was recorded as having 16 egg cases in its uteri.

The whale shark is a versatile suction filter-feeder, and feeds on a wide variety of planktonic and nektonic organisms. Masses of small crustaceans are regularly reported, along with small and not so small fishes such as sardines, anchovies, mackerels, and even small tunas and albacore as well as squids. The whale shark feeds at or close to the surface, and often assumes a vertical position with its mouth above. Phytoplankton often occurs in the stomachs of whale sharks, but whether this is a major component of the diet of this shark is rather doubtful. The suction-filter mechanism of the whale shark is more versatile than the dynamic filter mechanism of the basking shark in the range of prey species that can be taken. The basking shark, with its scooplike mouth, hydrodynamically 'clean' gillrakers, and huge gill slits, has little if any suction capacity and must depend on its relatively slow forward motion to carry animals into its mouth; this limits it to eating small planktonic crustaceans and other invertebrates. The whale shark is not dependent on forward motion to operate its filters, and can probably achieve relatively high intake velocities of water into its mouth, that enable it to readily ingest larger, active nektonic prey in addition to masses of planktonic crustaceans. A disadvantage of the suction plankton feeding of the whale shark over the dynamic method used by the basking shark is that the structures involved can filter a far smaller volume of water per unit time and hence are far less efficient in concentrating diffuse plankters. Hence the whale shark may be more dependent on high concentrations of plankters than the basking shark to optimally utilized such food, but has the option of utilizing nektonic organisms for prey.

The whale shark is generally considered harmless, and very large individuals have been examined and ridden by divers without the sharks reacting aggressively, although they may show curiosity and approach divers to apparently examine them. However, there have been a few cases of whale sharks butting sportsfishing boats, possibly after being excited and hooked fishes being played from the boats or by bait. More often human beings inadvertently assault whale sharks, by ramming them with ships and boats as they bask on the surface.

The whale shark has been kept in captivity in Japan; at the time of writing this account a good-sized individual has been housed in a large oceanarium tank in Okinawa for over a year, and feeds readily at the surface of the tank.

Size : Maximum total length uncertain, possibly to 18 m, but specimens rare above 12 m; 13.7 m is often given as the maximum measured, 12.1 m the most recently accurately measured. Most reported in the literature are between 4 and 12 m. Females of 438 to 562 cm are immature. This is by far the world's largest fish.

Interest to Fisheries : Apparently of relatively limited interest for fisheries. Small harpoon fisheries exist in Pakistan and India; it may also be taken in China, and has been captured and utilized in Senegal; it is eaten by people either fresh or dried salted and used to treat boat hulls in Pakistan.

Literature : Gudger (1915), Bigelow & Schroeder (1948); Iwasaki (1970); Bass, d'Aubrey & Kistnasamy (1975b); Johnson (1978); Wolfson & de Sciara (1981); Cadenat & Blache (1981); Wolfson (1983); S. Uchida (pers. comm.).

8. ORDER LAMNIFORMES - MACKERAL SHARKS

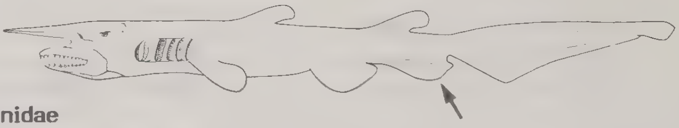
Order Lamniformes Compagno, 1973c, J.Linn.Soc.(Zool.), 53 Suppl. 1:37 p.

Synonymy : Order Asterospondyli: Gill, 1893 (in part); Fowler, 1941 (in part); Smith, 1949 (in part). Order Asterospondyli, Suborder Galei: Jordan & Evermann, 1896 (in part). Superorder Carcharhini, Order Squatinidae, Suborder Squaloidei: Glikman, 1967 (in part, for Cetorhinidae). Order Carcharhiniformes: Rass & Lindberg, 1971 (in part, for Cetorhinidae). Suborder Carchariina: Fowler, 1967 (in part). "Group" Carcharoidei: Garman, 1913 (in part). Order Euselachii, Suborder Galeoidei: Blot, 1969 (in part). Order Galea, Suborder Isurida: White, 1936, 1937 (in part). Suborder Galei: Gill, 1872 (in part), Jordan, 1923 (in part). Order Galeiformes, Suborder Isuroidea: Arambourg & Bertin, 1958 (in part). Suborder Galeiformes: Lozano y Rey, 1928 (in part); Budker & Whitehead, 1971 (in part). Suborder Galeoidea: Romer, 1945, 1966 (in part), Bigelow & Schroeder, 1948 (in part); Norman, 1966 (in part). "Division" Galeoidei: Regan, 1906 (in part). Suborder Galeoidei: Engelhardt, 1913 (in part). Order Isuriformes: Chu & Wen, 1979. "Group" Isuroidei: Garman, 1913 (in part). Suborder Lamnae, Order Odontaspida: Glikman, 1967 (in part, except for Cetorhinidae). Order Lamniformes: Rass & Lindberg, 1971 (in part, except for Cetorhinidae), Applegate, 1974. Order Lamniformes, Suborder Lamnoidei: Berg, 1940 (in part); Berg & Svedovidov, 1955 (in part), Patterson, 1967 (in part). Suborder Lamniformes: Bertin, 1939 (in part). Suborder Lamnina: Matsubara, 1955 (in part). Order Lamnoidea, suborder Galeoidea: Schultz & Stern, 1948 (in part). Suborder Lamnoidei: Lindberg, 1971 (in part); Nelson, 1976 (in part). Suborder Scylloidei: Goodrich, 1909 (in part). Suborder Squali: Gill, 1862 (in part).

Diagnostic Features : Trunk cylindrical and not raylike. Head conical to cylindrical and not laterally expanded; 5 pairs of gill slits present on sides of head, either entirely in front of pectoral bases or with the last two above the pectoral bases; spiracles usually present and very small, well behind the eyes; nostrils without barbels, circumnarial grooves, or nasoral grooves, well separated from eyes, with anterior nasal flaps not expanded and far from mouth; eyes lateral or slightly dorsolateral on head, without nictitating lower eyelids; snout very short and bluntly rounded to long and conical or flattened, usually not bladelike and not formed as a rostral saw with lateral teeth and vertral barbels; mouth moderately large to very large, strongly arched, extending well behind eyes; labial furrows short or absent, when present on lower jaw; teeth usually well differentiated along jaws, with enlarged anterior teeth, a gap or small intermediate teeth separating the anterior teeth from the lateral teeth in the upper jaw, but with posterior teeth not enlarged. Two dorsal fins, without spines, the first with its origin over the interspace between pectoral and pelvic bases or over the pectoral bases; pectoral fins moderate-sized to large but not raylike, without triangular anterior lobes; pelvic fins small to moderately large, with vent continuous with their inner margins; anal fin present; caudal fin with a long dorsal lobe but with ventral lobe varying from long (but shorter than the dorsal lobe) to absent; vertebral axis raised into the dorsal caudal lobe. Intestinal valve of ring type.

Key to Families :

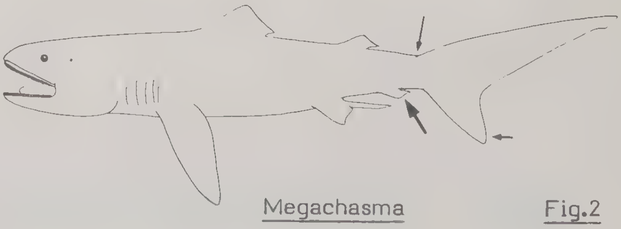
1a. Snout greatly elongated and flattened, forming a dagger-like blade. No precaudal pits. Ventral caudal lobe absent. Anal fin broadly rounded (Fig. 1) - Goblin sharks .... **Family Mitsukurinidae**



Mitsukurina Fig.1

1b. Snout very short to moderately elongated, conical to flattened and broadly rounded but not bladelike. Precaudal pits and ventral caudal lobe present. Anal fin angular

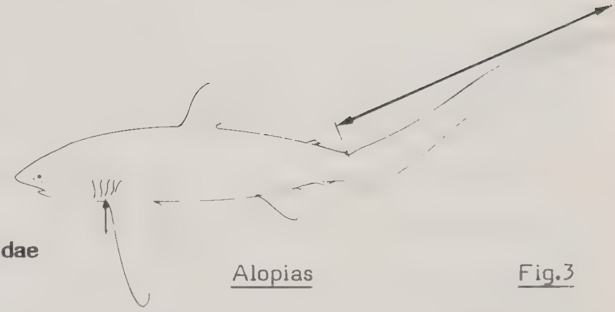
2a. Snout very short and broadly rounded in dorsoventral view. Mouth greatly enlarged, terminal on head. Teeth very small, numerous, over 50 rows in each jaw half, and not differentiated into anteriors, laterals, and symphyseals; no intermediates or intermediate gap in upper jaw. Internal gill openings with papillose gillrakers (Fig. 2) - Megamouth sharks .... **Family Megachasmidae**



Megachasma Fig.2

2b. Snout longer and narrowly to broadly parabolic in dorsoventral view. Mouth small to moderately large, subterminal on head. Teeth larger, less numerous, and less than 50 rows in each jaw half, and differentiated into anteriors, laterals and often symphyseals (symphyseals absent in some species); upper jaw with intermediate teeth or an intermediate gap between anterior and lateral teeth. Internal gill openings without rakers

3a. Caudal fin about as long as rest of shark. Last two gill openings above pectoral fin base (Fig. 3) -Thresher sharks .... **Family Alopidae**

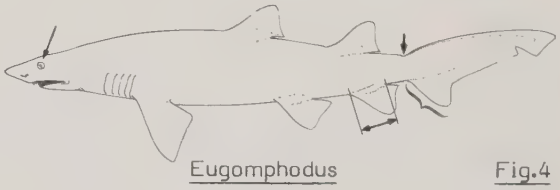


Alopias Fig.3

3b. Caudal fin much shorter than rest of shark. All gill openings in front of pectoral fin base

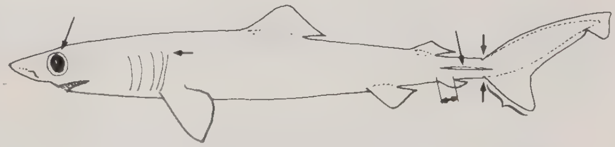
4a. Caudal fin asymmetrical, not lunate, ventral caudal lobe short, preventral caudal margin much shorter than dorsal caudal margin. Caudal peduncle without lateral keels or with weak ones

5a. Eyes relatively small, body stout. Anal fin broad-based, not pivoting. Caudal peduncle with an upper precaudal pit but without a lower pit or lateral keels. Gill openings not extending onto dorsal surface of head (Fig. 4) - Sand tiger sharks ....**Family Odontaspididae**



Eugomphodus Fig.4

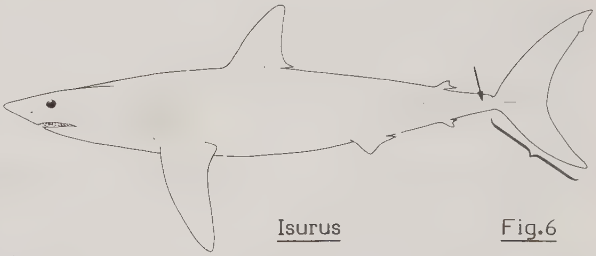
5b. Eyes very large, body slender. Anal fin narrow-based, pivoting. Caudal peduncle with both upper and lower precaudal pits and low lateral keels on each side. Gill openings extending onto dorsal surface of head (Fig. 5) - Crocodile sharks .... **Family Pseudocarchariidae**



Pseudocarcharias Fig.5

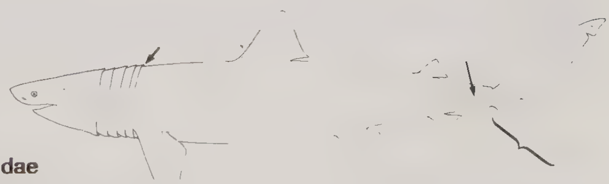
4b. Caudal fin nearly symmetrical and lunate, with a long ventral lobe and preventral caudal margin nearly as long as dorsal caudal margin. Caudal peduncle with very strong lateral keels

6a. Teeth relatively few, enlarged and bladelike, with less than 40 rows in each jaw. Gill openings large but not extending onto dorsal surface of head; internal gill openings without gillrakers (Fig. 6) - Mackeral sharks .... **Family Lamnidae**



Isurus Fig.6

6b. Teeth numerous, minute, hooked and not bladelike, with over 150 rows in each jaw. Gill openings extremely large, extending onto dorsal surface of head; internal gill openings with prominent gillrakers formed from modified dermal denticles (Fig. 7) - Basking sharks .... **Family Cetorhinidae**



Cetorhinus Fig.7

8.1 FAMILY ODONTASPIDIDAE Müller & Henle, 1839

Family Odontaspides Müller & Henle, 1839, Syst.Beschr.Plagiost., pt. 2:73. Family Odontaspididae (correction of Odontaspides) placed on the Official List of Family-Group Names in Zoology (Name no. 385) and Odontaspides placed on the Official Index of Rejected and Invalid Family-Group Names in Zoology (Name no. 414) by the International Commission on Zoological Nomenclature, Opinion 723 (1965).

Synonymy : Subfamily Triglochidini Bonaparte, 1838 (Family Squalidae).

FAO Names : En - Sand tiger sharks; Fr - Requins de sable; Sp - Solrayos, Toros.

Field Marks : Large sharks, with conical to slightly depressed, pointed snouts, long mouths extending behind eyes, small eyes without nictitating eyelids, moderately long gill openings, large teeth with slender cusps and lateral cusplets, small intermediate teeth separating anterior and lateral teeth in the upper jaw, two large dorsal fins and an anal fin, small pectoral fins, a compressed caudal peduncle without keels but with an upper precaudal pit, and an asymmetrical caudal fin with a strong but short ventral lobe.

Diagnostic Features : Trunk compressed-cylindrical and moderately stout. Head short, much shorter than trunk, snout short to moderately long, pointed and conical to slightly depressed, not greatly elongated, flattened and bladelike; eyes small to moderately large; mouth large, ventral on head; gill openings moderately large, not extending onto dorsal surface of head, all anterior to pectoral fin bases; no gillrakers on internal gill slits; teeth large, anteriors narrow and awl-like but laterals moderately compressed and bladelike, less than 60 rows in either jaw; two or three rows of large anterior teeth on each side of upper jaw, three in lower, the uppers separated from the upper lateral teeth by one of five rows of small intermediate teeth or a gap. First dorsal fin large, moderately high, erect and angular; second dorsal and anal fins about as large as first dorsal or somewhat smaller, with broad, nonpivoting bases, pectoral fins moderately long and broad, much shorter than head in adults; pelvic fins large, nearly or quite as large as first dorsal fin; caudal fin not lunate, upper lobe moderately long, less than half as long as rest of shark, lower lobe short but strong. Upper precaudal pit present, caudal peduncle compressed and without keels.

Habitat, Distribution and Biology : Odontaspids are tropical to cool-temperate, inshore and deepwater sharks with a wide geographic distribution in virtually all seas, in continental and insular waters from the surf zone to the outer shelves and down the slopes to possibly 1600 m. All the known species are of large size (to at least 360 cm).

These sharks are relatively slow but active littoral and epibenthic swimmers. They feed on a wide variety of bony fishes, other sharks, rays, squids and bottom crustaceans. Development is ovoviviparous, without a yolk-sac placenta but with uterine cannibalism.

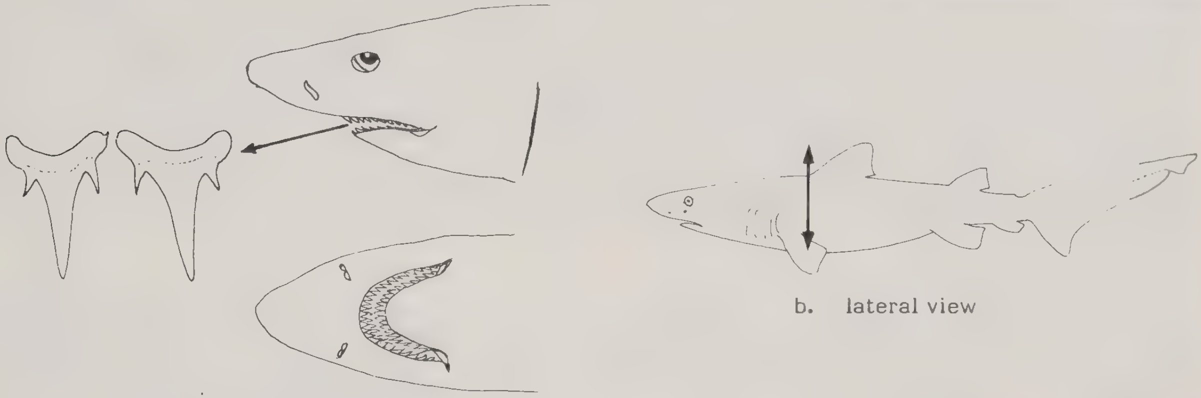
Sand tiger sharks are relatively inoffensive and usually unaggresive to humans in the water. Swimmers, divers, and fishermen commonly encounter inshore members of the family (genus Eugomphodus), but despite their impressive teeth there have been few attacks by these sharks on people. In some areas these sharks have a fearsome reputation as 'maneaters', but this is primarily a result of confusion with other species (especially with requiem sharks, family Carcharhinidae). As with other large sharks, the sand tigers should be regarded as potentially dangerous and should not be harassed or provoked underwater. Inshore sand tigers superficially resemble the carcharhinid lemon shark (Negaprion), which can be extremely aggressive when provoked.

Interest to Fisheries : The species of Eugomphodus are important for inshore and offshore fisheries where they occur, while Odontaspis species are less so, being less abundant and less valuable than Eugomphodus species.

Remarks : The arrangement of species and genera in this family follows revisionary work by the author. Reviews of this family include Bigelow & Schroeder (1948), d'Aubrey (1964), and Bass, d'Aubrey & Kistnasamy (1975b). Although most writers recognize only one genus of Odontaspididae, two genera are included here for the living species. This follows recent palaeontological work (for example, Glikman, 1964, 1967, Herman, 1975) that treats the taurus and ferox groups of species as separate genera, but also morphological studies on these species groups that revealed their distinctness (Compagno, unpub. data).

Key to Genera :

1a. Snout long and conical (Fig. 1a). Two rows of large upper anterior teeth on each side of symphysis. First dorsal fin noticeably larger than second, closer to pectoral bases than pelvic bases (Fig. 1b) .... **Odontaspis**

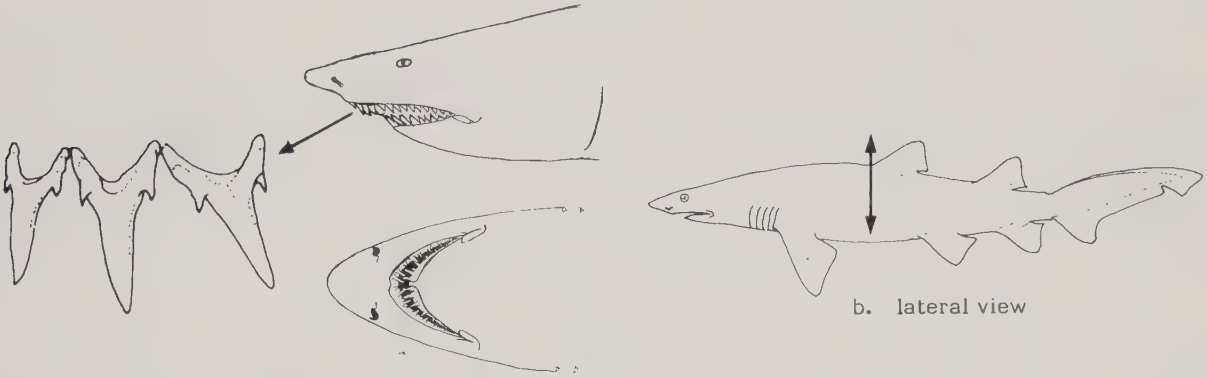


a. lateral and ventral view of head with teeth

b. lateral view

Odontaspis Fig.1

1b. Snout short and flattened (Fig. 2a). Three rows of large upper anterior teeth on each side of symphysis. First dorsal fin about as large or slightly larger than second, closer to pelvic bases than pectoral bases (Fig. 2b) ....**Eugomphodus**



a. lateral and ventral view of head with teeth

b. lateral view

Eugomphodus Fig.2

Eugomphodus Gill, 1862

ODONT Eug

Genus : Eugomphodus Gill, 1862, Proc.Acad.Nat.Sci.Philad., 1861:60 (name only, but with allocated species; Gill, 1865, Ibid., 1864:260.

Type Species : Eugomphodus griseus Gill, 1862 by monotypy, equals Carcharias griseus Storer, 1846 and Carcharias taurus Rafinesque, 1810.

Synonymy : Genus Carcharias Rafinesque, 1810. Placed on the Official Index of Rejected and Invalid Generic Names in Zoology (Name no. 1746) by the International Commission on Zoological Nomenclature, Opinion 723.5a (1965). Genus Triglochis Müller & Henle, 1837. Placed on the Official Index of Rejected and Invalid Generic Names in Zoology (Name no. 1747) by the International Commission on Zoological Nomenclature, Opinion 723.5b (1965). Subgenus Synondontaspis White, 1931 (Genus Odontaspis Agassiz, 1838); Subgenus Paradontaspis White, 1931 (Genus Odontaspis Agassiz, 1838).

Diagnostic Features : Snout short and somewhat flattened; eyes small; three rows of large upper anterior teeth and usually no symphyseal teeth on each side of symphysis; posterior teeth well differentiated from lateral teeth, with cusps and cusplets reduced or absent, molariform. First dorsal base closer to pelvic bases than to pectoral bases, with its origin well behind inner margins of pectorals and its insertion about over pelvic origins; second dorsal fin about as large as first dorsal; anal fin about as large or slightly larger than dorsal fins and with its origin under midbase of second dorsal.

Remarks : Work on the cranial, vertebral, dental, and external morphology of odontaspids revealed that members of the *taurus* species group in *Carcharias* or *Odontaspis* are generically separable from the *ferox* group, which comprises the genus *Odontaspis sensu stricto*. The oldest genus-group names for the *taurus* group were *Carcharias* Rafinesque, 1810 and *Triglochis* Müller & Henle, 1837, but these were rejected by the International Commission on Zoological Nomenclature (1965), following an argument by White *et al.* (1962). In regards to *Carcharias* Rafinesque, 1810, White, Tucker & Marshall (1961) reason that because the genus *Odontaspis* Agassiz, 1838 has been used far more frequently in the literature for odontaspidids (especially fossils) than *Carcharias*, *Carcharias* should be suppressed. A key point to these author's reasoning is that "...since the respective nominal type species of *Carcharias* Rafinesque, 1810, and *Odontaspis* J.L.R. Agassiz, 1838, *are congeneric*, it is the latter name which is threatened by the former" (emphasis added). However, subsequent work indicates that the two type species, *taurus* and *ferox*, are *not* congeneric, and, provided two genera of living odonstaspidids are recognized, *Odontaspis* is not threatened by *Carcharias*. In lieu of a reversal of Opinion 723.5a by the International Commission on Zoological Nomenclature to reinstate the genus *Carcharias* Rafinesque, 1810, the next valid genus-group name for the *taurus* group is *Eugomphodus* Gill, 1862, which is used here and elsewhere (Compagno, 1977, Welton & Zinsmeister, 1980).

Key to Species :

1a. Labial furrows absent. Snout broadly rounded in dorsoventral view[*].................................... ***E. tricuspidatus***

1b. Labial furrows present on lower jaw. Snout narrowly rounded in dorsoventral view .... ***E. taurus***

Eugomphodus taurus (Rafinesque, 1810)

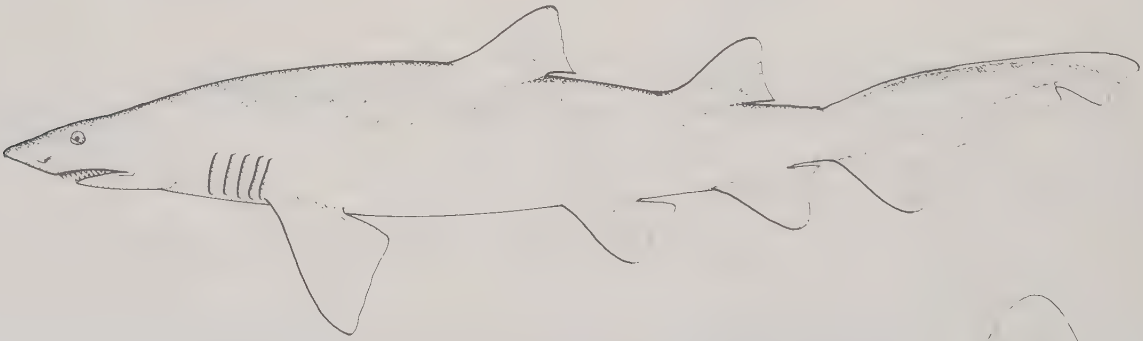
ODONT Eug 1

Carcharias taurus Rafinesque, 1810, *Caratt.gen.sp.anim.piant.Sicilia, Palermo*, pt. 1:10, pl. 14, fig. 1. Holotype: Unkown. Type Locality: Sicily, Mediterranean Sea.

Synonymy : *Squalus americanus* Mitchell, 1815 (not *S. americanus* Gmelin, 1789 = *Dalatias lichia*); *Squalus littoralis* LeSueur, 1817; *Squalus macrodus* Mitchell, 1817; *Carcharias griseus* Ayres, 1843; *Odontaspis americanus* Abbott, 1861; ? *Odontaspis cinerea* Macleay, 1880 (*nomen nudum*); *Lamna ecarinata* Hemprich & Ehrenberg, 1899; *Carcharias arenarius* Ogilby, 1911; *Carcharias owstoni* Garman, 1913; ? *Squalus lixa* Larranaga, 1923; *Odontaspis platensis* Lahille, 1928.

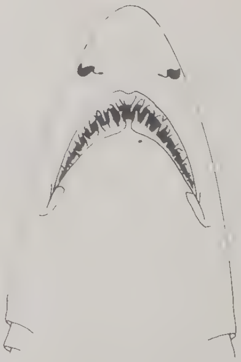
Other Scientific Names Recently in Use : *Odontaspis taurus* (Rafinesque, 1810); *Carcharias platensis* (Lahille, 1928).

FAO Names : En - Sandtiger shark; Fr - Requin taureau; Sp - Toro bacota.



Field Marks : A large, bulky shark. Head with a flattened-conical snout, eyes without nictitating eyelids, mouth long and extending behind eyes, teeth large, with prominent narrow cusps and lateral cusplets, upper anterior teeth separated from lateral teeth by small intermediate teeth. Anal fin and both dorsal fins equally large and broad-based, first dorsal fin on back closer to pelvic fins than pectorals, upper precaudal pit present, but lateral keels absent from caudal peduncle, caudal fin asymmetrical but with a strong ventral lobe. Colour: light brown, often with darker reddish or brownish spots scattered on body.

Diagnostic Features : Possibly rounded-pointed snout and absence of labial furrows (see account of *Eugomphodus tricuspidatus*).



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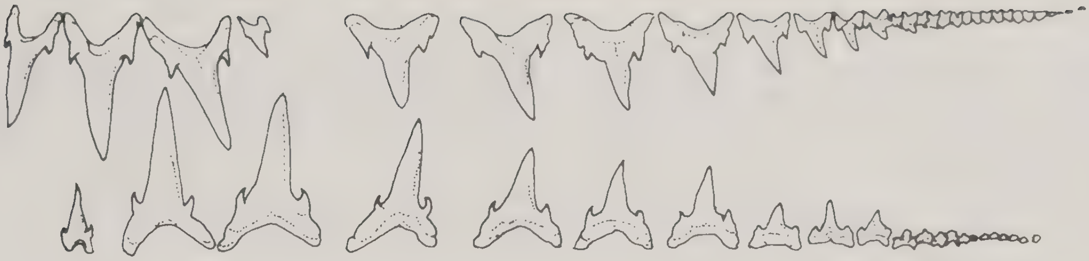
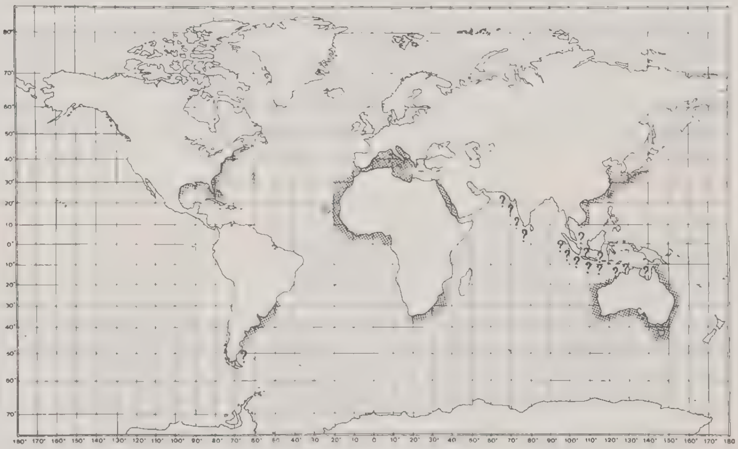
[*] Characters taken from the original account of *E. tricuspidatus* by Day (1878) and not confirmed in recent accounts of this species (which better fit *E. taurus*) or by specimens



upper and lower teeth
from left side



Geographical Distribution : Western Atlantic: Gulf of Maine to Florida, northern Gulf of Mexico, Bahamas, Bermuda; southern Brazil to Argentina. Eastern Atlantic: Mediterranean to Canary Islands; Cape Verde Islands, Senegal, Ghana, southern Nigeria to Cameroon. Western Indian Ocean: South Africa to southern Mozambique; Red Sea, Pakistan, ? India. Western Pacific: ? Indonesia, ? Viet Nam, Japan, China; Australia (Queensland, New South Wales, Victoria, Tasmania, South Australia, Western Australia).

Habitat and Biology : This is a common littoral shark in temperate and tropical waters where it occurs. It ranges from the surf zone, in shallow bays, and around coral and rocky reefs down to at least 191 m depth on the outer shelves. This species is often found near or on the bottom but also occurs in midwater or at the surface. It is a strong but slow midwater swimmer that is more active at night. This shark is denser than water, but it swallows air at the surface and holds it in its stomach to maintain approximately neutral buoyancy. Like a bony fish with a swimbladder, it is capable of hovering motionless in the water. It is a very hardy species that readily adapts to captivity and can live for many years and even give birth in adequate tank facilities.

This species occurs as solitary individuals or in small to large schools. It is strongly migratory in parts of its range, particularly in its northern and southern extremities where pronounced poleward migrations occur in summer and equatorial movements in autumn and winter. Aggregations of individuals occur for feeding, courtship, mating, and birth. Off South Africa courtship and mating apparently occurs in the more tropical parts of its range, while pregnant females give birth in warm-temperate waters.

Reproduction in this species is better known than in most other lamnoids and features ovophagy or uterine cannibalism. There are normally two young in a litter, one per uterus. Eggs leave the ovaries, and while in transit in the oviducts are fertilized and enclosed in groups of 16 to 23 in egg cases. However, at some time between fertilization and birth only one embryo of its group prevails, possibly by devouring its rivals, and this proceeds to eat fertilized eggs and smaller potential siblings in utero until birth. Unlike ovoviviparous non-cannibal and viviparous species, the yolk sac is resorbed at a small size, less than 17 cm, and the umbilical scar may be lost. At 17 cm, fetuses have sharp, functional teeth and are feeding; at about 26 cm, they can swim in utero; size at birth is very large, about 1 m. The gestation period may be 8 to 9 months long.

This shark is a voracious feeder on a wide variety of bony fishes including herrings, croakers, bluefishes, bonitos, butterfishes, snappers, hakes, eels, wrasses, mullets, spadefishes, sea robins, sea basses, porgies, remoras, sea catfishes, flatfishes, jacks, and undoubtedly many others, as well as small sharks (Carcharhinidae and Triakidae), rays (Myliobatidae), squids, crabs and lobsters. Schools of this shark have been observed to feed cooperatively, surrounding and bunching schooling prey and then feeding on them.

As the "grey nurse" shark, this species has a bad reputation as a maneater in Australian waters, but this is apparently due to confusion with other species, particularly requiem sharks (Carcharhinidae). Observations of this shark underwater suggest that it is primarily inoffensive and unaggresive towards people when not provoked, though its size and jagged dentition should invite respect. However, it can be stimulated to harass and attack people, particularly when they are spearfishing. Cases are known of this shark stealing fish off stringers and spears underwater, underlining the desirability of boating one's catch as soon as possible when this shark or others are about. Relatively few documented attacks by this shark on people have been reported. On the other hand, divers armed with powerheads and other underwater weapons have found this slow-moving species an easy target in some areas (particularly Australia); such crude and barbaric 'sport', analogous to shooting domestic cattle with a pistol, has caused a decline in the number of these sharks where it occurs.

Size : Maximum total length about 318 cm, mature males 220 to 257+ cm, mature females 220 to 300+ cm, size at birth 95 to 105 cm.

Interest to Fisheries : Generally fished in all areas where it is found, but of variable importance regionally; it is highly regarded for food in Japan but not in the western Atlantic. It is caught primarily with line gear but also fixed bottom gillnets, and in pelagic and bottom trawls. The meat of this shark is utilized fresh, frozen, smoked and dried salted for human consumption; it is also used for fishmeal, its liver for oil, its fins for the oriental sharkfin trade.

Local Names : AUSTRALIA: Gray nurse shark; SOUTH AFRICA: Spotted ragged-tooth shark.

Literature : Whitley (1940); Bigelow & Schroeder (1948); Springer (1948); Cadenat (1956a); Lineaweaver & Backus (1970); Bass, d'Aubrey & Kistnasamy (1975b).

Remarks : Included as synonyms of E. taurus are a number of regional species that have often been considered valid in the older literature, but which are most likely local representatives of a single, wide-ranging species. The dentitional characters most often sued to distinguish these species (see Bigelow & Schroeder, (1948) apparently vary considerably within samples from a given area (Applegate, 1965, Sadowsky, 1970, Taniuchi, 1970). These include Squalus americanus and its synonyms from the western North Atlantic, Odontaspis platensis from the western South Atlantic, Carcharias owstoni from the western North Pacific, and Carcharias arenarius from Australia. Abe et al. (1968, 1969), Sadowsky (1970), Taniuchi (1970), and Whitley & Pollard (1980) have all used the species name taurus for the local representatives of the species formerly named owstoni, arenarius, and platensis.

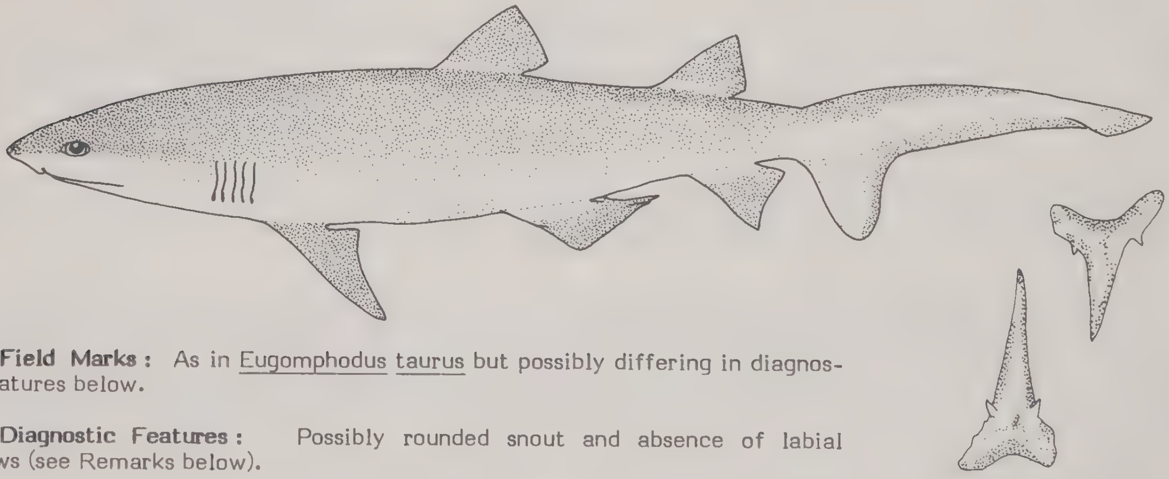
Eugomphodus tricuspidatus (Day, 1878)

ODONT Eug 2

Carcharias tricuspidatus Day, 1878, Fish.India, 713, pl. 186, fig. 1. Holotype: Apparently lost (P.K. Talwar, pers.comm.). Type Locality: India.

Synonymy : ? Carcharias cuspidatus Ogilby, 1888 (error ?).

FAO Names : En - Indian sand tiger; Fr - Requin taureau bambak; Sp - Toro bambaco.



lower and upper tooth

Field Marks : As in Eugomphodus taurus but possibly differing in diagnostic features below.

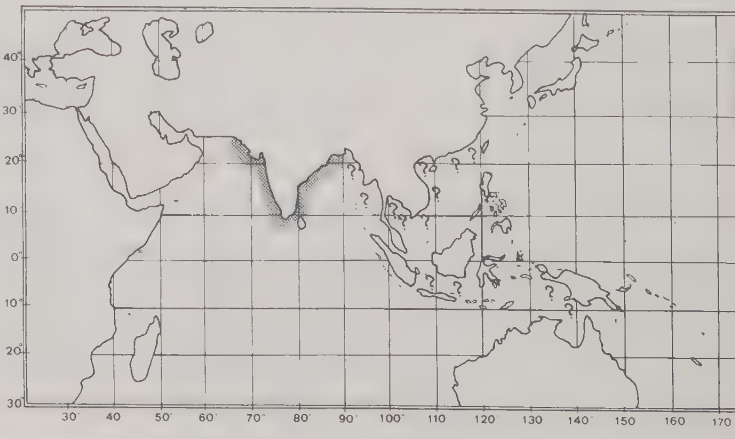
Diagnostic Features : Possibly rounded snout and absence of labial furrows (see Remarks below).

Geographical Distribution : Indo-West Pacific: India, Pakistan, ? Indonesia, ? Indochina, ? Australia, ? Philippines, ? northern China.

Habitat and Biology : An inshore and offshore, littoral shark; biology little known if distinct from E. taurus.

Size : Said to reach 3.7 or more metres total length, possibly to at least 6.1 m (Day, 1878), but this is unlikely.

Interest to Fisheries : Apparently fished in India and Pakistan.



Literature : Day (1878); Fowler (1941).

Remarks : This species is poorly known, and may be a junior synonym of E. taurus. Day's (1878) original description stated that it lacked labial furrows and pictured it as having a broadly rounded snout (E. taurus has a rounded-angular snout and well-developed labial furrows). However, since the species was described from a skin, now lost, it is possible that the reported snout shape is in error and the labial furrows were overlooked. Day's (1878, pl. 186, fig. 1) drawing of the snout of his Carcharias tricuspidatus might even be based on Negaprion acutidens, though the lateral view and tooth illustrated are very similar to those of E. taurus. During a trip to India in 1982, I was unable to examine any specimens of Eugomphodus from India (which is apparently much less common there than many carcharhinids) and was unable to confirm or deny the validity of this species. I prefer to consider it a species dubium for the present.

Odontaspis Agassiz, 1838

ODONT Odont

Genus : Odontaspis Agassiz, 1838, Recher.Poiss.Foss., 3:86, 87. Placed on Official List of Generic Names in Zoology (Name no. 1659) by the International Commission on Zoological Nomenclature, Opinion 723.3c (1965).

Type Species : Carcharias ferox Risso, 1826, by monotypy, equals Squalus ferox Risso, 1810.

Synonymy : None.

Diagnostic Features : Snout long and conical; eyes moderately large; a symphyseal tooth row and two rows of large upper anterior teeth at each side of symphysis; posterior teeth grading into lateral teeth, cuspidate, with prominent cusplets, and not molariform. First dorsal base closer to pectoral bases than to pelvic bases, with its origin over inner margins of pectorals and its insertion well anterior to pelvic origins; second dorsal fin about half as large as first dorsal; anal fin somewhat smaller than second dorsal and with its origin under or behind second dorsal insertion.

Remarks : The genus Odontaspis as presently delimited is restricted to species related to O. ferox. The taurus species group is included in the genus Eugomphodus. Carcharias kamoharai Matsubara, 1936 (and its synonyms) have previously been placed in the genus Odontaspis (or Carcharias) by d'Aubrey (1964) and Bass, d'Aubrey & Kistnasamy (1975b), but this species is very distinctive and is here placed in the genus Pseudocarcharias and the family Pseudocarchariidae.

Key to Species :

1a. Teeth mostly with two or three cusplets on each side of cusp. Three or four rows of small intermediate teeth between upper anterior and lateral rows. Second dorsal fin origin over or slightly posterior to insertions of pelvic fins .... **O. ferox**

1b. Teeth with only one cusplet on each side of cusp. One row of small intermediate teeth between upper anterior and lateral rows. Second dorsal origin over midbase of pelvics .... **O. noronhai**

Odontaspis ferox (Risso, 1810)

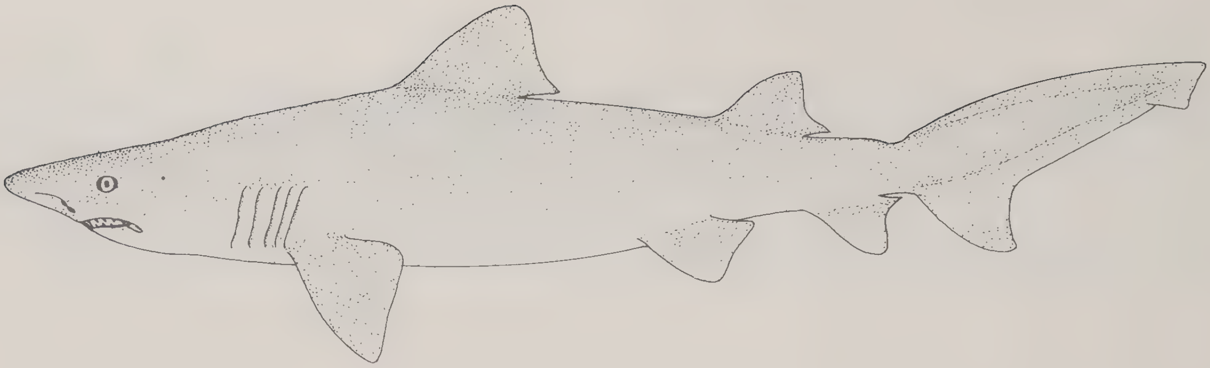
ODONT Odont 1

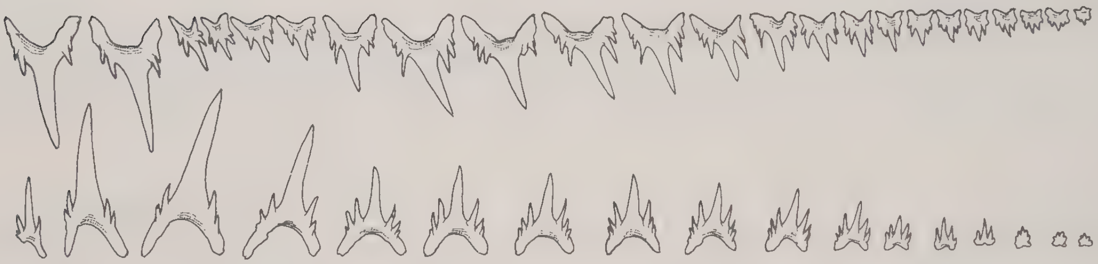
Squalus ferox Risso, 1810, Ichthyol.Nice, Paris, 38; Carcharias ferox Risso, 1826, Hist.nat.Princip.Prod. Europe Méred., Paris, Poissons, 3:122. Carcharias ferox. Placed on the Official List of Specific Names in Zoology (Name no. 2057), by the International Commission on Zoological Nomenclature, Opinion 723.4.c (1965). Holotype: Unknown. Type Locality: Off Nice, France, Mediterranean Sea.

Synonymy : Odontaspis herbsti Whitley, 1950.

Other Scientific Names Recently in Use : Carcharias ferox.

FAO Names : En - Smalltooth sand tiger; Fr - Requin féroce; Sp - Solrayo.

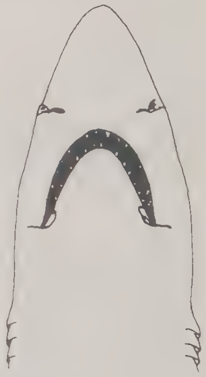




upper and lower teeth
from left side

Field Marks : A large, bulky shark with a long, bulbously conical snout, eyes moderately large, without nictitating eyelids, mouth long and extending behind eyes, teeth moderately large, with prominent narrow cusps and 2 or more pairs of lateral cusplets, upper anterior teeth separated from lateral teeth by 3 to 5 rows of small intermediate teeth. Anal fin and second dorsal fin smaller than first dorsal but broad-based, first dorsal fin on back and closer to pectoral fins than pelvics, upper precaudal pit present but lateral keels absent from caudal peduncle, caudal fin asymmetrical but with a strong ventral lobe. Colour: medium grey, sometimes with darker reddish spots scattered on body.

Diagnostic Features : Teeth mostly with 2 or 3 pairs of lateral cusplets, root lobes deeply arched and narrow; 3 to 5 rows of small intermediate teeth between upper anterior and lateral tooth rows. First dorsal fin with its posterior margin sloping posteroventrally from its apex; origin of second dorsal fin about over rear ends of pelvic bases; anal fin high and erect, height almost equal to base length; length of dorsal margin of caudal fin about 30% of total length in young. Colour: medium grey above, lighter below, young with black-tipped dorsal fins, some individuals with dark reddish spots.



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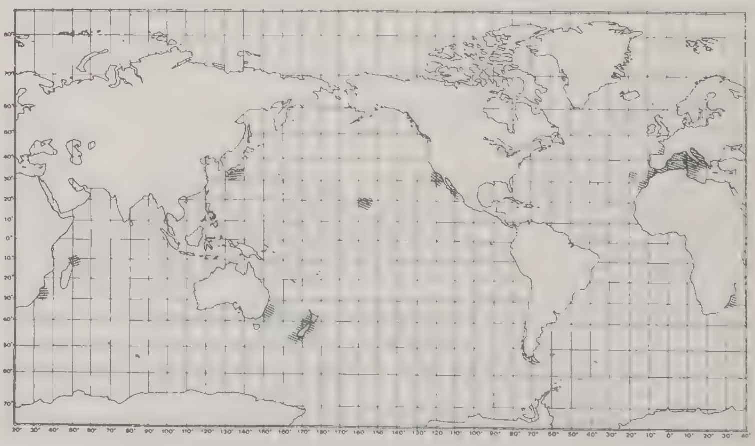


Geographical Distribution : Eastern North Atlantic: Gulf of Gascony, Madeira, Morocco, Mediterranean. Western Indian Ocean: South Africa, ? Madagascar. Western Pacific: Japan, Australia (New South Wales). Central Pacific: Hawaiian Islands. Eastern Pacific: Southern California, Gulf of California.

Habitat and Biology : This shark is a little-known inhabitant of deepish water in warm-temperate and tropical seas, on or near the bottom on continental and insular shelves and upper slopes at depths of 13 to 420 m. Reproduction is unknown in the species, but presumably is similar to *Eugomphodus taurus*. It feeds on small bony fishes, squids and shrimps. Its teeth are noticeably smaller and less robust than those of *E. taurus*, suggesting that it takes smaller and possibly less active prey than the latter. Also, its dentition is more weakly differentiated along the jaws, with its lateral teeth less specialized for cutting than E. taurus and its posterior teeth not differentiated into specialized crushers; this suggests a more uniform diet of softer prey than in E. taurus. Probably its deepwater habitat does not allow this shark to regulate its buoyancy by gulping air as in E. taurus; it does, however, have a longer body cavity than E. taurus, with a very large, oily liver, and presumably uses this organ as its primary hydrostatic structure. It is not implicated in attacks on people.

Size : Maximum total length about 360 cm, male mature at 275 cm, females to 360 cm, size at birth above 105 cm.

Interest to Fisheries : This uncommon species is primarily taken in the Mediterranean Sea and off Japan with bottom gillnets, line gear, and bottom trawls. It is used for human food (its flesh is considered far inferior to that of Eugomphodus taurus in Japan) and for its liver, which is very large, oily and has a reasonably high squalene content.

Literature : Maul (1955); Tortonese (1956); Daugherty (1964); Abe et al. (1968); Garrick (1974); Bass, d'Aubrey & Kistnasamy (1975b); Taniuchi (1983).

Remarks : Garrick (1974) recognized Odontaspis herbsti for members of the genus from New Zealand, Australia, California and Madeira that differed from the Mediterranean O. ferox only in lacking spots. This was followed by Bass, d'Aubrey & Kistnasamy (1975b) for South African spotless individuals, but Robins et al. (1980:69) noted that specimens from California may have spots or lack them. Apparently presence of spots is a matter of individual variation in what is here considered a single species O. ferox. Eugomphodus taurus is also variable in presence of spots.

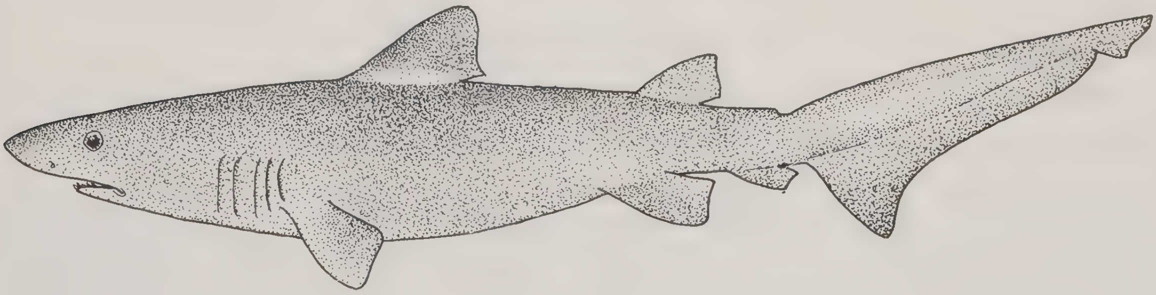
Odontaspis noronhai (Maul, 1955)

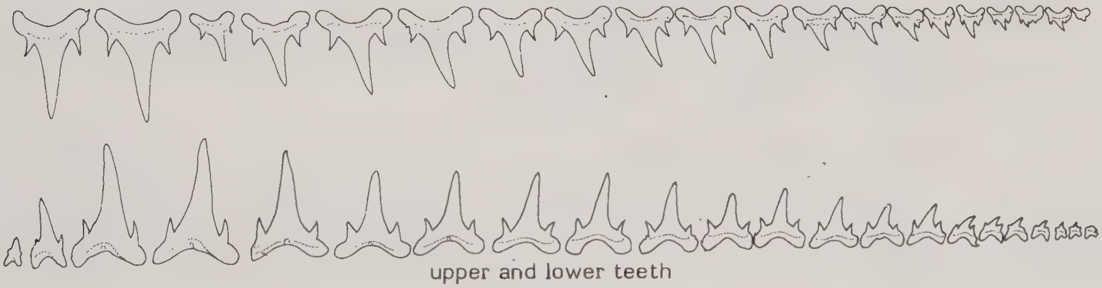
ODONT Odont 2

Carcharias noronhai Maul, 1955, Notul.Nat.Acad.Nat.Sci.Philad., (279):3, figs 1-4. Holotype: Museu Municipal do Funchal, Madeira, NMF-2691, 1710 mm female. Type Locality: Off Camara de Lobos, Madeira, between 600 and 1600 m depth and most likely at 800 to 1000 m depth.

Synonymy : None.

FAO Names : En - Bigeye sand tiger; Fr - Requin noronhai; Sp - Solrayo ojigrande.



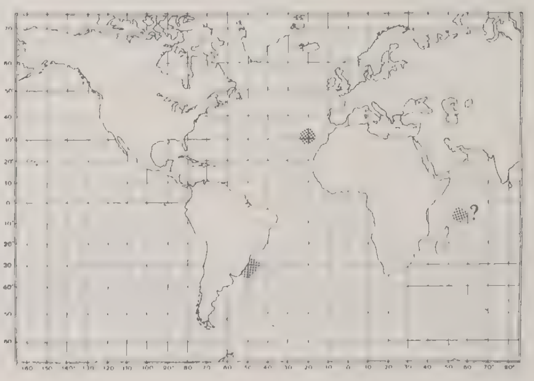


upper and lower teeth
from left side

Field Marks : A large, bulky shark. Head with a long, bulbously conical snout, eyes very large, without nictitating eyelids; mouth long and extending behind eyes; teeth moderately large, with prominent narrow cusps and lateral cusplets; upper anterior teeth separated from lateral teeth by one row of small intermediate teeth. First dorsal fin on back and closer to pectoral fins than pelvics; upper precaudal pit present but lateral keels absent from caudal peduncle; caudal fin asymmetrical but with a strong ventral lobe; anal fin and second dorsal fin smaller than first dorsal but broad-based. Colour: uniform dark chocolate brown, without spots.

Diagnostic Features : Teeth with a single pair of lateral cusplets, root lobes moderately arched and broad; one row of small intermediate teeth between upper anterior and lateral tooth rows. First dorsal fin with its posterior margin extending vertically from its apex; origin of second dorsal fin about over first thirds of pelvic bases; anal fin low and rounded, height much less than base length; length of dorsal margin of caudal fin about 33% of total length in young. Colour: uniform chocolate brown, without spots.

Geographical Distribution : Eastern South Atlantic: Southern Brazil. Eastern North Atlantic: Madeira. Western Indian Ocean: Seychelles?



Habitat and Biology : A poorly known deepwater shark, formerly known only from the stuffed Madeira holotype, but recently collected at considerable depths off southern Brazil (V. Sadowsky, pers.comm., 1982). Apparently an inhabitant of continental and insular slopes at 600 to 1000 m depth or more. Reproduction and feeding habits unknown.

Size : Maximum total length about 360 cm, two adult males from 326 to 342 cm long and an adult female about 326 cm (V. Sadowsky, pers.comm.).

Interest to Fisheries : The holotype was taken on a vertical longline set by fishermen for black scabbardfish (Aphanopus carbo). Presumably taken occasionally by deepwater fisheries.

Literature : Maul (1955); V. Sadowsky (pers.comm.).

Remarks : Compagno (1981a) recognized this species but suggested that it possibly was only an extreme variant of O. ferox; however, additional evidence convinced the writer that it is a valid species, readily separable from O. ferox. A set of jaws possibly from the Seychelles (D. Ward, pers. comm.) has the dentitional characters of this species, and is the basis for the Indian Ocean record of O. noronhai.

8.2 FAMILY MITSUKURINIDAE Jordan, 1898

MITSU

Family Mitsukurinidae, Jordan, 1898, Proc.Calif.Acad.Sci.(Zool.), 1:201.

Synonymy : ? Family Scapanorhynchidae White, 1936 (see discussion under genus Mitsukurina).

FAO Names : En - Goblin sharks; Fr - Requins lutin; Sp - Tiburones duende.

Diagnostic Features : Trunk compressed and moderately slender, very soft and flabby. Head as long as trunk or slightly shorter; snout greatly elongated, bladelike and flattened; eyes very small; mouth large, ventral on head; gill openings short, not extending onto dorsal surface of head, all anterior to pectoral fin bases; no gillrakers on internal gill slits; teeth large, anteriors and laterals very narrow and awl-like, less than 60 rows in either jaw; three rows of large anterior teeth on each side of upper and lower jaws, the uppers separated from the upper lateral teeth by a gap without intermediate teeth. Dorsal fins small, low, and rounded, or semi-angular, equal sized and smaller than the large, rounded anal fin; second dorsal and anal fins with broad, nonpivoting bases; pectoral fins small and broad, much shorter than head in adults; pelvic fins large, larger than dorsal fins; caudal fin not lunate, upper lobe long but half length of rest of shark or less, lower lobe not developed, no precaudal pits, caudal peduncle compressed and without keels.

Mitsukurina Jordan, 1898

MITSU Mitsu

Genus : Mitsukurina Jordan, 1898, Proc.Calif.Acad.Sci.(Zool.), 1:199.

Type Species : Mitsukurina owstoni Jordan, 1898, by monotypy.

Synonymy : None.

Remarks : Mitsukurina is often synonymized with the Upper Cretaceous fossil genus Scapanorhynchus Woodward, 1889, following Woodward (1899), but the two are apparently at least generically distinct (Signeux, 1949; Cappetta, 1980). The type species of Scapanorhynchus, S. lewisi (Davis, 1887) is known from whole-bodied specimens that show many differences from Mitsukurina owstoni. Some palaeontologists (Glikman, 1967; Shelton P. Applegate, pers.comm.) place Scapanorhynchus in a separate family (Scapanorhynchidae) from Mitsukurina, but others (Herman, 1975; Cappetta, 1980) include them both in the Mitsukurinidae. Despite dentitional and other differences, the presence of a greatly expanded, paddlefish-like rostrum in both genera is strongly suggestive of relationship between them.

Following White (1936, 1937), many workers used the family name Scapanorhynchidae for the goblin shark (including Fowler, 1941; Bigelow & Schroeder, 1948; Bass, d'Aubrey & Kistnasamy, 1975b), but Mitsukurinidae has priority.

Mitsukurina owstoni Jordan, 1898

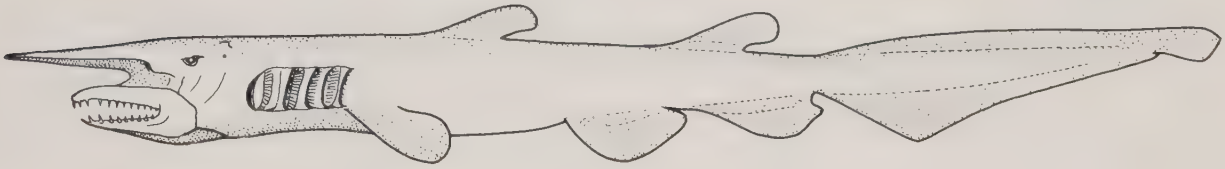
MITSU Mitsu 1

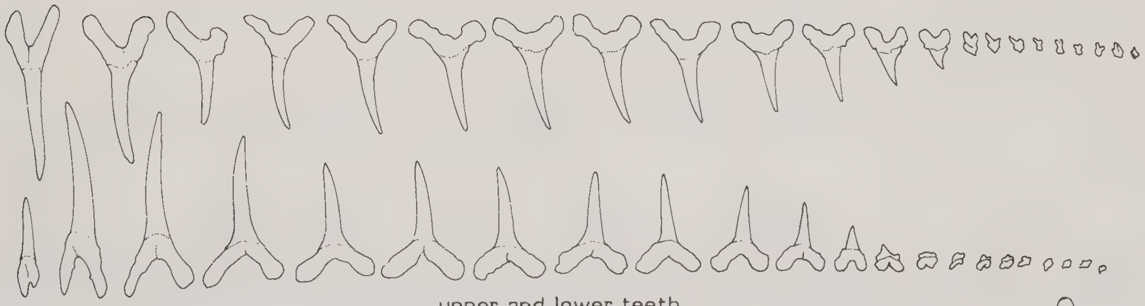
Mitsukurina owstoni Jordan, 1898, Proc.Calif.Acad.Sci.(Zool.), 1:200, pls 11-12. Holotype: Zoological Museum, University of Tokyo. Type Locality: Near Yokohama, Japan in deep water.

Synonymy : Odontaspis nasutus de Braganza, 1904; Scapanorhynchus jordani Hussakoff, 1909; Scapanorhynchus dofleini Engelhardt, 1912; Scapanorhynchus mitsukurii White, 1937 (error for Mitsukurina owstoni).

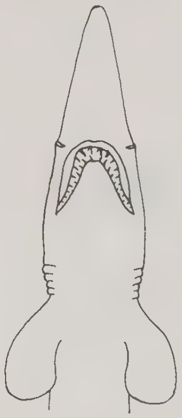
Other Scientific Names Recently in Use : Scapanorhynchus owstoni (Jordan, 1898).

FAO Names : En - Goblin shark; Fr - Requin lutin; Sp - Tiburón duende.





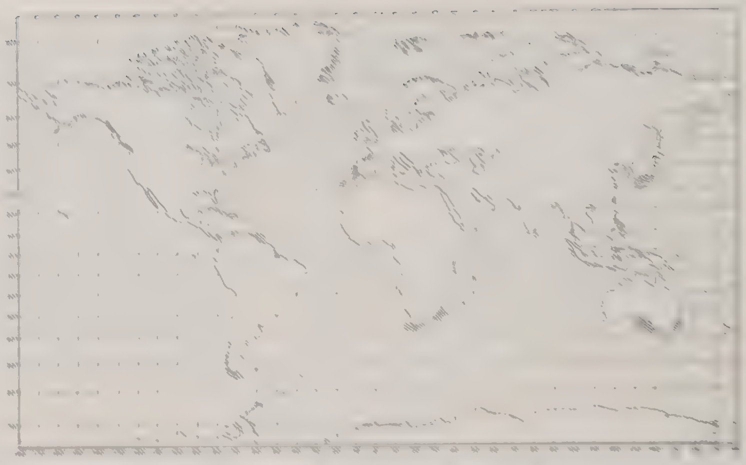
upper and lower teeth
from left side



underside of head

Field Marks : This unmistakable shark has a flat, bladelike, elongated snout, tiny eyes without nictitating eyelids, soft, flabby body, slender, very long-cusped teeth in long, protrusible jaws, two spineless dorsals and an anal fin, and a long caudal fin without a ventral lobe. Preserved specimens are brownish, but newly caught specimens are pinkish-white when still alive (see Uyeno, 1976 for spectacular colour photographs of living individuals).

Diagnostic Features : See family.



Geographical Distribution : Western Atlantic: French Guiana. Eastern Atlantic: France (Bay of Biscay), Madeira, Portugal; Cape of Good Hope, South Africa. Western Indian Ocean: Off South Africa. Western Pacific: Japan, Australia (South Australia, New South Wales).

Habitat and Biology : A poorly known, uncommon, bottom dwelling shark that inhabits the outer continental shelves and upper slopes down to at least 550 m, but rarely occurs in shallow water close inshore. Almost nothing is known of the biology of this bizarre shark. The long caudal fin, without a ventral lobe, soft, flabby body, and small, soft paired and unpaired fins, suggest that the goblin shark is a relatively inactive, slow swimming species with a density close to seawater. Its remarkable bladelike snout is superficially similar to those of the teleost paddlefishes (Polyodontidae), and like these fishes may use it as a forward-projecting prey detector. Its slender, pick-like anterior and lateral teeth suggests small, soft-bodied prey including fishes, shrimps and squids; as in Eugomphodus taurus, its posterior teeth are modified for crushing. The jaws of the goblin shark are highly specialized for rapid projection from the head as in some mesopelagic teleosts, and probably function to snap up small animals. It is harmless to people.

Size : Maximum total length about 335 cm; males mature at 264 to 322 cm.

Interest to Fisheries : Minimal, taken as bycatch of deepwater trawl fisheries and occasionally taken with deepwater longlines, deep-set gillnets, and possibly purse seines. Utilized dried salted.

Literature : Bean (1905); Fowler (1941); Bigelow & Schroeder (1948); Bass, d'Aubrey & Kistnasamy (1975b); Uyeno (1976); Piotrovsky & Prut'ko (1980).

8.3 FAMILY PSEUDOCARCHARIIDAE Compagno, 1973

PSEUD

Family Pseudocarchariidae Compagno, 1973c, J.Linn.Soc.(Zool.), 53, suppl. 1:28.

Synonymy : None.

FAO Names : En - Crocodile sharks; Fr - Requins crocodile; Sp - Tiburones cocodrilo.

Diagnostic Features : Trunk cylindrical and slender. Head short, much shorter than trunk; snout moderately long, pointed and bulbously conical, not greatly elongated, flattened and bladelike; eyes very large; mouth large, ventral on head; gill openings long, extending onto dorsal surface of head, all in front of pectoral fin bases; no gillrakers on internal gill slits; teeth large, the anteriors narrow and awl-like, the laterals more compressed and blade-like, with less than 30 rows in either jaw; two rows of anterior teeth on each side of upper and lower jaws, the uppers separated from the upper lateral teeth by a row of small intermediate teeth. First dorsal fin small, low, and angular, second dorsal smaller than first but larger than anal fin; second dorsal with a broad, nonpivoting base but anal fin pivotable; pectoral fins small, short and broad, much shorter than head in adults; pelvic fins large, somewhat smaller than pectoral and first dorsal fins; caudal fin not lunate, upper lobe moderately long but less than half as long as rest of shark, lower lobe, short but strong; precaudal pits present, caudal peduncle slightly depressed and with low lateral keels.

Remarks : The single living species in this family was formerly placed in the family Odontaspididae and genus Odontaspis or Carcharias, but anatomical work by the writer has shown that this species is very distinct and rates a separate family, Pseudocarchariidae. Characters of the family are presented and discussed in Compagno (1973c, 1977, 1982).

Pseudocarcharias Cadenat, 1963

PSEUD Pseud

Genus : Subgenus Pseudocarcharias Cadenat, 1963 (genus Carcharias Rafinesque, 1809), Bull.Inst.Franç.Afr. Noire, ser. A, 25(2):526 (proposed as a subgenus but used in generic form).

Type Species : Pseudocarcharias pelagicus Cadenat, 1963, by original designation, equals Carcharias kamoharai Matsubara, 1936.

Synonymy : None.

Remarks : This genus has been included as a synonym of Carcharias Rafinesque, 1810 (d'Aubrey, 1964) and Odontaspis Agassiz, 1838, but is strongly different from either Odontaspis or Eugomphodus as delimited here and has been recognized by a number of writers (Abe et al., 1969, Compagno 1973c, 1977, 1981a, 1982, Krefft, 1980, Fujita, 1981).

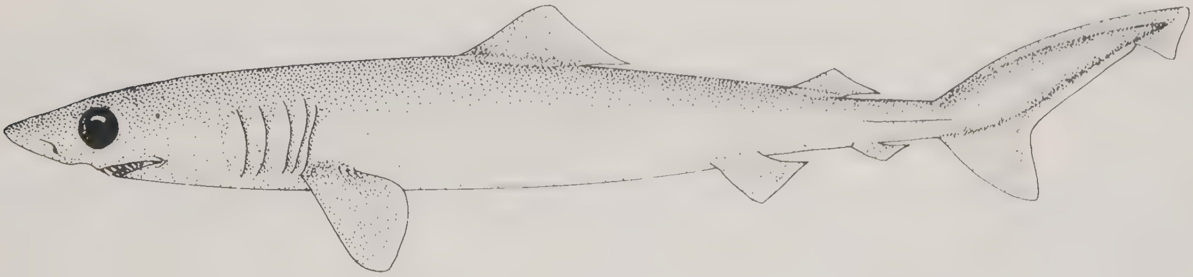
Pseudocarcharias kamoharai (Matsubara, 1936)

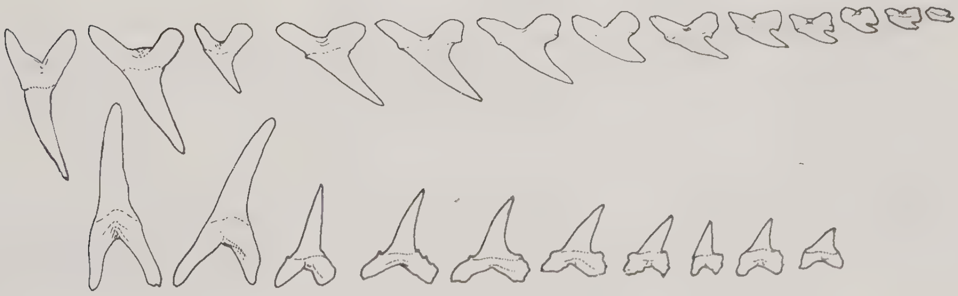
PSEUD Pseud 1

Carcharias kamoharai Matsubara, 1936a, Zool.Mag.Tokyo, 48(7):380. Holotype: Imperial Fisheries Institute, Japan, Fish Spec. 1823, 735 mm male. Type Locality: Koti Fish Market, Japan.

Synonymy : Carcharias yangi Teng, 1959; Pseudocarcharias pelagicus Cadenat, 1963.

FAO Names : En - Crocodile shark; Fr - Requin crocodile; Sp - Tiburón cocodrilo.

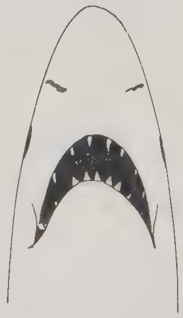




upper and lower teeth
from left side

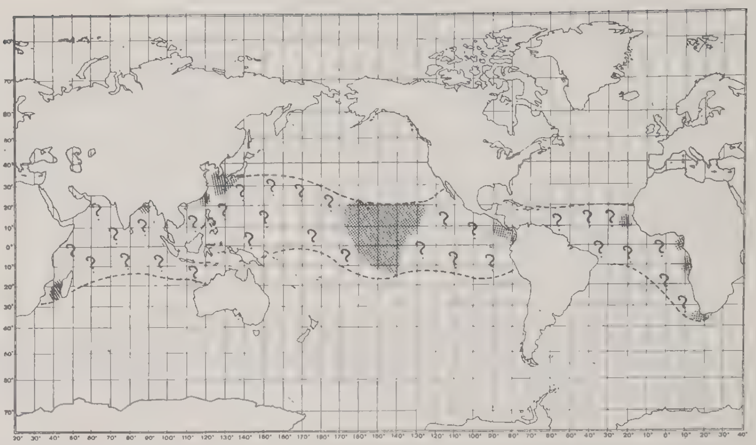
Field Marks : A small, very distinctive oceanic shark, with huge eyes lacking nictitating eyelids, long gill slits, slender, spindle-shaped body, long-cusped, prominent teeth in a long, angular mouth with highly protrusible jaws, small pectoral fins, two small, spineless dorsal fins and an anal fin, weak keels and precaudal pits on the caudal peduncle, and an asymmetrical caudal fin with a long ventral lobe.

Diagnostic Features : See family.



underside of head

Geographical Distribution : Nearly circumtropical. Eastern Atlantic: South east of Cape Verde Islands, between them and Guinea Bissau, Guinea, Angola, and South Africa (southwest Cape seas). Western Indian Ocean: Mozambique Channel southwest of southern Madagascar. ? Eastern Indian Ocean: Bay of Bengal (possibly erroneous). Western North Pacific: Off Japan, Taiwan Island and the Koreas. Central Pacific: Marquesas Islands, Hawaiian Islands, open ocean between Marquesas and Hawaiian islands, open ocean between Hawaiian Islands and Baja California. Eastern Pacific: Off Costa Rica and Panama.



Habitat and Biology : A rare to locally abundant oceanic, epipelagic and possibly mesopelagic shark, usually found offshore and far from land but sometimes occurring inshore and near the bottom, at depths from the surface to at least 300 m. The long body cavity, large liver, and small fins of this shark give it a superficial resemblance to Isistius, Squaliolus, Euprotomicrus, and other oceanic squaloids, and like these squaloids its extremely oily liver is probably important in maintaining neutral buoyancy. Its habits are little-known, but its firm body musculature, small precaudal fins, and large caudal fin suggests that it is relatively active but perhaps sporadically so. The large eyes of the crocodile shark suggest nocturnal or deepwater activity, and possibly a diel pattern of movement toward the surface at night and away from it in the day.

The crocodile shark is ovoviviparous and a uterine cannibal, with the young having yolk sacs at 3 or 4 cm long but resorbing them and subsisting on fertilized eggs and probably other embryos beyond this size. Number of young in a litter 4, 2 per uterus; egg cases formed in the oviducts have 2 to 9 fertilized eggs, but apparently only 2 of these survive, possibly through elimination of extra rivals. An interesting question is why do two young survive in each uterus in this shark and some other lamnoids, while in Eugomphodus taurus only one fetus per uterus is normally produced.

Feeding habits of this shark are little known, but its long, flexed teeth suggests small to moderately large, active oceanic prey. Of 5 specimens examined by the writer, the stomachs of 4 were empty and the fifth (a subadult male) had a number of small bristlemouths (gonostomatids) and possibly lanternfishes (myctophids) as well as small shrimps and squid beaks. The jaws of the crocodile shark can be protruded a considerable distance from its head.

The crocodile shark has never been involved in attacks on people and is regarded as not dangerous to people, particularly because of its small size and slender, non-cutting teeth; but its powerful jaws and jaw muscles and the size of its teeth should invite respect. It snaps strongly and vigorously when captured (S. Kato, pers.comm.) and can bite very hard.

Size : This is the smallest living lamnoid, with maximum total length at least 110 cm; males adult at 74 to 110 cm, females adult at 89 to 102 cm, size at birth about 41 cm.

Interest to Fisheries : This shark is primarily caught by the Japanese pelagic longline fisheries, but details are sketchy. Abe et al. (1969) noted that the species is often caught on tuna longlines, but discarded because of its small size and meat that is apparently unsuitable for the Japanese market. The liver of this species is very large and very high in squalene, and hence is of potential value.

Literature : Cadenat (1956); d'Aubrey (1964); Abe et al. (1969); Abe (1973); Bass, d'Aubrey & Kistnasamy (1975b); Compagno (1973c, 1981, 1982); Fujita (1981).

Remarks : The common name is derived from one of its Japanese common names, Mizu-wani (water crocodile or alligator). The synonymy of this shark follows Bass, d'Aubrey & Kistnasamy (1975b).

8.4 FAMILY MEGACHASMIDAE Taylor, Compagno & Struhsaker, 1983

MEGA

Family Megachasmidae Taylor, Compagno & Struhsaker, 1983, Proc.California Acad.Sci., ser. 4, 43(8):87.

Synonymy : None.

FAO Names : En - Megamouth sharks; Fr - Requins grande gueule; Sp - Tiburones bocudos.

Diagnostic Features : Trunk cylindrical and somewhat compressed, stout. Head very long, about length of trunk; snout extremely short, flattened and broadly rounded, not elongated and bladelike; eyes moderately large; mouth extremely large, terminal on head; gill openings moderately long, not extending onto dorsal surface of head, the last two over pectoral fin bases; unique gillrakers of fingerlike dermal papillae with cartilage cores fringing internal gill slits; teeth small, continuously varying and more or less awl-shaped, over 100 rows in either jaws, no anteriors, intermediate teeth or gaps in each upper dental band. First dorsal fin moderately large, semierect and angular; second dorsal less than half size of first but moderately large; pectoral fins large, narrow and elongated, much shorter than head in adults; pelvic fins moderate-sized, smaller than pectoral and first dorsal fins; anal fin smaller than second dorsal and with its base slightly behind second dorsal base, bases of both fins not pivotable; caudal fin not lunate, upper lobe long but less than half as long as rest of shark, lower lobe short but strong; precaudal pits present, caudal peduncle compressed and without lateral keels.

Remarks : This new, highly distinct family is discussed in Taylor, Compagno & Struhsaker (1983).

Megachasma Taylor, Compagno & Struhsaker, 1983

MEGA Mega

Genus : Megachasma Taylor, Compagno & Struhsaker, 1983, Proc.California Acad.Sci., ser.4, 43(8):87.

Type Species : Megachasma pelagios Taylor, Compagno & Struhsaker, 1983, by original designation.

Synonymy : None.

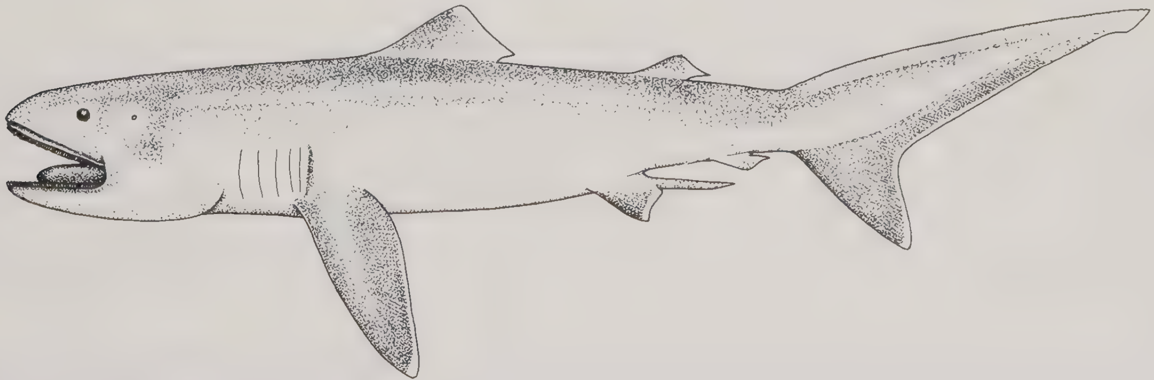
Megachasma pelagios Taylor, Compagno & Struhsaker, 1983

MEGA Mega 1

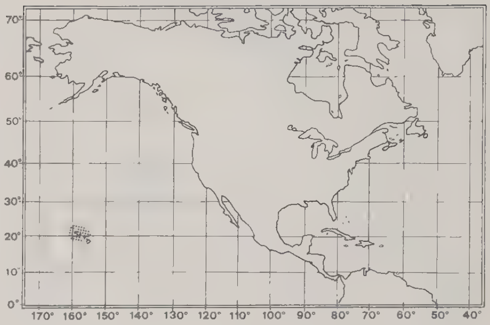
Megachasma pelagios Taylor, Compagno & Struhsaker, 1983, Proc.California Acad.Sci., ser. 4, 43(8):87, figs. 1-15. Holotype: Bernice P. Bishop Museum, Honolulu, Hawaii, BPBM-22730, 4460 mm adult male. Type Locality: Off Oahu, Hawaiian Islands, 21°51'N, 157°46'W, about 42 km northeast of Kahuku Point, at 165 m depth in water about 4600 m deep.

Synonymy : None.

FAO Names : En - Megamouth shark; Fr - Requin grande gueule; Sp - Tiburón bocudo.



Field Marks : One of three species of gigantic filter-feeding sharks, unmistakable with its extremely short but broadly rounded snout, very large and long head, huge terminal mouth that extends behind the eyes, numerous small hooked teeth, moderately long gill slits, internal gill slits lined with dense rows of papillose gillrakers, eyes without nictitating eyelids, two dorsal fins and an anal fin, caudal peduncle without keels, caudal fin asymmetrical, not lunate, but with a short and strong ventral lobe, and no light spots.



Diagnostic Features : See family.

Geographical Distribution : Known only from the type locality, but likely to be wide-ranging, like other gigantic, plankton-feeding sharks.

Habitat and Biology : At present known only from the holotype, which was caught in the open ocean, in the epipelagic zone near the Hawaiian Islands at 165 m depth. This shark had been feeding on euphausiid shrimp, Thysanopoda pectinata, that averages 3.1 cm in length. As the shark has greatly reduced teeth, very numerous gillraker papillae, on its internal gill slit, and stomach packed with very small euphasiid prey, it can be properly considered a specialized filter feeder like the basking shark (Cetorhinus maximus) and whale shark (Rhiniodon typus). However, the flabby body, soft fins, asymmetrical caudal fin without keels, and weak calcificiation of the megamouth shark suggest that it is much less active than the whale and basking sharks. The only known prey of the megamouth shark is a common epipelagic and mesopelagic shrimp in the area where the shark was captured. The shrimp has a diel migration pattern with a range of 300 to 1100 m depth during the day; at night it is commonest at 150 to 500 m with a maximum range of 75 to 525 m. When captured, the megamouth shark was apparently at the upper depths where these shrimp are commonest, and possibly might have been feeding on them when it fouled itself by its mouth and teeth on a pair of parachutes being used as sea anchors by a US Navy research vessel. The megamouth shark is the only known selachian victim of the semiparasitc cookiecutter shark, Isistius brasiliensis, and may be especially vulnerable to Isistius attacks because of its soft skin, midwater habitat, and probable sluggishness. The feeding habits and habitat of the megamouth shark suggest that it will be a rare catch in the future, but it may show up in large purse seines operated by tuna boats. The feeding structures of this shark may allow it to feed on other pelagic invertebrates and even small midwater fishes.

Size : The holotype is an adult male, at 446 cm total length.

Interest to Fisheries : None at present.

Literature : Taylor, Compagno & Struhsaker (1983).

Remarks : This recently described shark, a giant pelagic filter-feeder, is perhaps the most spectacular discovery of a new shark in the Twentieth Century.

8.5 FAMILY ALOPIIDAE Bonaparte, 1838 (emended)

ALOP

Subfamily Alopidiani Bonaparte, 1838 (Family Squalidae), Nuov.Ann.Sci.Nat., Bologna, 2:209.

Synonymy : Family Alopeciae Müller & Henle, 1839; Family Vulpeculidae Garman, 1913.

FAO Names : En - Thresher sharks; Fr - Renards; Sp - Zorros.

Field Marks : Long, curving asymmetrical caudal fin, with dorsal lobe nearly or quite as long as rest of shark, short ventral lobe, long narrow pectoral fins, large to huge eyes.

Diagnostic Features : Trunk cylindrical and moderately stout. Head short, much shorter than trunk; snout moderately long, pointed and conical, not greatly elongated, nor flattened and bladelike; mouth small and arcuate, ventral on head; teeth small to moderately large, compressed and bladelike, in less than 60 rows in either jaw; two rows of small to moderately large anterior teeth on each side of both jaws, the anteriors separated from the upper laterals by a row of small intermediate teeth or a gap; eyes moderately large to very large; gill openings short, not extending onto dorsal surface of head, last two pairs over pectoral fin bases; no gillrakers on internal gill slits. First dorsal fin large, high, erect and angular, second dorsal and anal fins minute, low and with pivoting bases, anal fin base behind second dorsal base; pectoral fins very long and narrow, longer than head in adults; pelvic fins very large, nearly or quite as large as first dorsal fin; caudal fin not lunate, upper lobe greatly elongated, about as long as rest of shark, lower lobe short but strong. Precaudal pits present, caudal peduncle slightly compressed and without keels.

Habitat, Distribution and Biology : Threshers are large, active, strong-swimming sharks, ranging in habitat from coastal to epipelagic and deepwater epibenthic. They are found worldwide in tropical, subtropical and cold-temperate waters. These sharks are apparently specialized for feeding on small to moderately large schooling fishes and squids. Threshers swim in circles around a school of prey, narrowing the radius and bunching the school with their long, straplike caudal fins. The caudal fin is also used as a whip to stun and kill prey, and threshers are commonly tail-hooked on longlines after striking the bait with the caudal tip. The three species of this family broadly overlap in habitat and range, but differences in their structure, feeding habits and spatial distribution suggest that they reduce interspecific competition by partitioning their habitat and available prey to some extent. Alopias superciliosus, with its huge eyes, relatively large teeth, broad caudal fin, and preference for deeper water (coastally near the bottom), takes somewhat larger pelagic fishes (including small billfishes and lancetfishes) as well as bottom fishes; A. vulpinus, with smaller eyes and teeth, a narrower caudal fin, and preference for the surface, takes small pelagic fishes (including clupeids, needlefishes and mackerels) and squids, but also bonitos and bluefishes. The oceanic A. pelagicus is poorly known, but its even smaller teeth and very slender caudal fin suggest that it may take smaller prey than A. vulpinus or A. superciliosus.

Interest to Fisheries : Thresher sharks form an important component of the oceanic shark fishery, particularly because of their high-quality meat which is utilized fresh, frozen, smoked and dried salted. Their fins are used for shark-fin soup, livers for vitamin extraction, and hides for leather. Sizeable pelagic thresher fisheries, utilizing floating longlines, have operated in the northwestern Indian Ocean, the central Pacific, and the western North Atlantic; recently an important pelagic gillnet thresher fishery has started off the California coast in the eastern Pacific. Threshers are also captured offshore and near shore with line gear (including rod and reel) and fixed bottom gillnets.

Remarks : Arrangement of this family follows Bass, d'Aubrey & Kistnasamy (1975b) and Gruber & Compagno (1982), in recognizing a single living genus and three living species.

Alopias Rafinesque, 1810

ALOP Alop

Genus : Alopias Rafinesque, 1810, Caratt.gen.sp.anim.piant.Sicilia, Palermo, pt. 1:13.

Type Species : Alopias macrourus Rafinesque, 1810 by monotypy, a junior synonym of Squalus vulpinus Bonnaterre, 1788).

Synonymy : Genus Vulpecula Jarocki, 1822 (also Garman, 1913); Genus Alopecias Müller & Henle, 1837; Genus Alopius Swainson, 1838; Genus Alopes Vladykov & McKensie, 1935 (error).

Key to Species :

1a. Head nearly flat between eyes; with a deep horizontal groove on nape on each side above gills. Eyes very large, with orbits expanded onto dorsal surface of head. Teeth larger, less than 25 rows in each jaw. First dorsal fin base closer to pelvic bases than pectoral bases .... **A. superciliosus**

1b. Head strongly arched between eyes; with no horizontal groove or with an inconspicuous one on nape on each side. Eyes smaller, with orbits not expanded onto dorsal surface of head. Teeth smaller, 29 or (usually) more rows in each jaw. First dorsal fin base about equidistant between pectoral and pelvic fin bases or closer to pectoral bases.

    2a. Head narrow, snout more elongated, forehead nearly straight. Labial furrows absent. Lateral teeth with well-developed distal cusplets. Pectoral fins nearly straight and broad-tipped. Terminal lobe of caudal shorter, its length from subterminal notch to caudal tip about equal to second dorsal base. Sides above pectoral bases dark, without an extension of the white abdominal area .... **A. pelagicus**

    2b. Head broad, snout shorter, forehead strongly arched. Labial furrows present. Lateral teeth usually without distal cusplets. Pectoral fins falcate and narrow tipped. Terminal lobe of caudal longer, its length from subterminal notch to caudal tip over twice second dorsal base. Sides above pectoral bases marked with a white patch extending forward from the abdominal area .... **A. vulpinus**

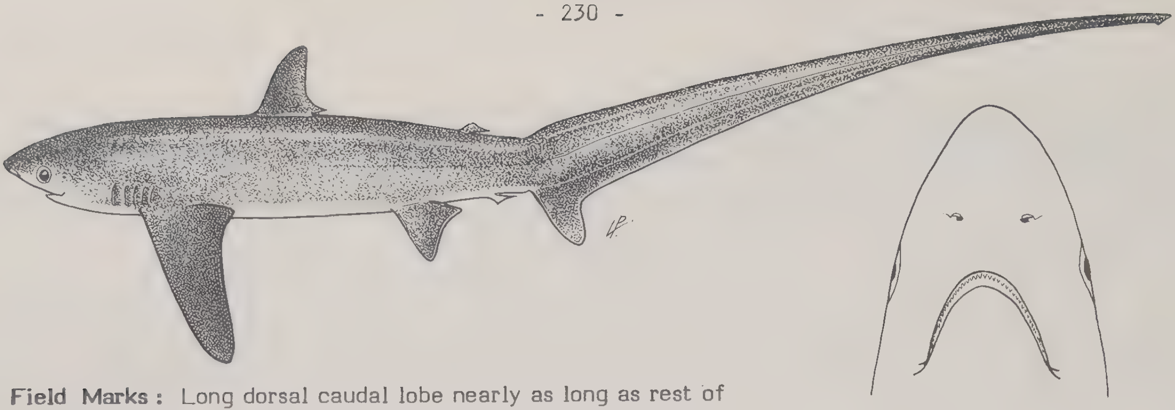
Alopias pelagicus Nakamura, 1935

ALOP Alop 3

Alopias pelagicus Nakamura, 1935, Mem.Fac.Sci.Agric.Taihohu Imp.Univ., 14(1):2, 3, pl. 1, fig. 2. Holotype: Uncertain. Type Locality: off Taiwan (Province of China), specimens examined in Suo, Taiwan (24°36'N, 52'E) fish market.

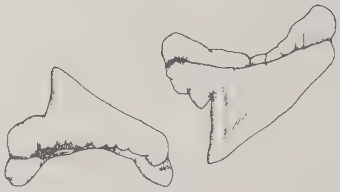
Synonymy : None.

FAO Names : En - Pelagic thresher; Fr - Renard pélagique; Sp - Zorro pelágico.



underside of head

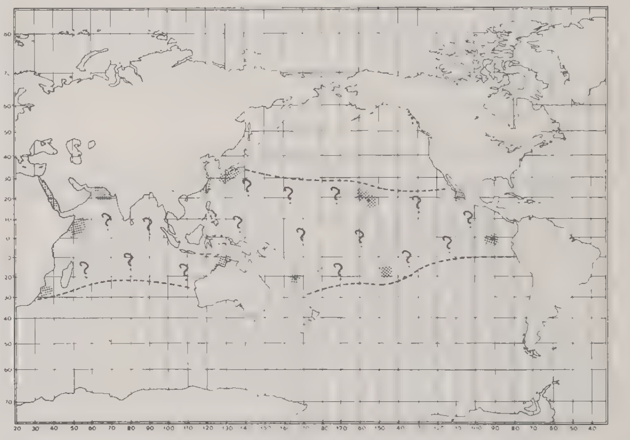
Field Marks : Long dorsal caudal lobe nearly as long as rest of shark, relatively small eyes, straight, broad-tipped pectoral fins, white colour of abdomen not extending over pectoral fin bases.



lower and upper tooth

Diagnostic Features : Eyes moderately large in adults, very large only in newborn and fetuses, with orbits not expanded onto dorsal surface of head; dorsal profile of head convex and forehead moderately convex in lateral view; space between dorsal edges of eyes broadly convex; snout moderately long, conical; an inconspicuous horizontal groove on each side of head above gills; labial furrows absent; teeth small, over 29 rows in either jaw. Pectoral fins not falcate, straight and broad-tipped; terminal lobe of caudal fin very small. White colour of abdomen not extending over pectoral fin bases.

Geographical Distribution : Oceanic and wide-ranging in the Indo-Pacific. Indian Ocean: South Africa, Red Sea, Arabian Sea (off Somalia, between Oman and India, and off Pakistan). Western North Pacific: China, Japan (southeastern Honshu). Western South Pacific: Australia (northwestern coast), New Caledonia, Tahiti. Central Pacific: Hawaiian Islands. Eastern Pacific: Mouth of Gulf of California to Galapagos Islands.



Habitat and Biology : Primarily an oceanic, epipelagic, circumtropical species, but sometimes caught near shore, ranging in depth from the surface to at least 152 m. A little-known, active, strong-swimming species. Ovoviviparous, with at least two young; apparently a uterine cannibal like other species of Alopias. Presumably feeds on small fishes and squid but no details are known. Harmless to people.

Size : This is quite evidently a smaller species than A. superciliosus or A. vulpinus. Maximum total length at least 330 cm, with males adolescent at 192 cm and adult at 276 cm; females may be immature (or adolescent) up to 277 cm, but adults range from 264 to 330 cm (Gohar & Mazhar, 1964, had an adult female 3 m long); size at birth about 96 cm.

Interest to Fisheries : This species has been mainly exploited by the longline fishery in the northwestern Indian Ocean (primarily by the USSR) but it also fished in the Central Pacific and probably elsewhere. Utilized for its meat (for human consumption), liver oil for vitamin extraction, hides for leather, and fins for shark-fin soup.

Literature : Bass, d'Aubrey & Kistnasamy (1975b); Mizue et al. (1981).

Remarks : Nakamura (1935, p. 3) described Alopias pelagicus from three large specimens 285 to 330 cm total length, one of which he illustrated (pl. 1, fig. 2). He also included a separate description (p. 5) and illustration (pl. 3) of at least one fetus (the one illustrated being about 97 cm long) under the name A. pelagicus. Nakamura did not designate type material and did not indicate if one of the three large specimens was the mother of the illustrated fetus or if the latter was separately obtained. Although the large pelagicus specimen illustrated by Nakamura appears to be the same species as the one termed A. pelagicus by Bass, d'Aubrey & Kistnasamy (1975b), the illustrated fetus may be A. vulpinus (recognizable by its small eyes, broad head with a strongly convex dorsal profile, short snout, presence of labial furrows, and falcate pectoral fins). I do not know if designated types exist for A. pelagicus, and if there is a holotype for the species. The name A. pelagicus is tentatively assigned here to the species recognized as pelagicus by Bass, d'Aubrey & Kistnasamy (1975b), with the cautionary note that Nakamura's type specimens (or specimen), if extant, might be based in whole or part on A. vulpinus.

Alopias pelagicus has commonly been mistaken for A. vulpinus. For example, Gohar & Mazhar (1964, Red Sea), Kato, Springer & Wagner (1967, Eastern Pacific), Fourmanoir & Laboute (1976, New Caledonia), Johnson (1978, Tahiti), and Faughnan (1980, Hawaiian Islands) have all published illustrations of this species under the name A. vulpinus. This species may be more wide-ranging than the present sparse records show, primarily because it has been misidentified as A. vulpinus in the literature.

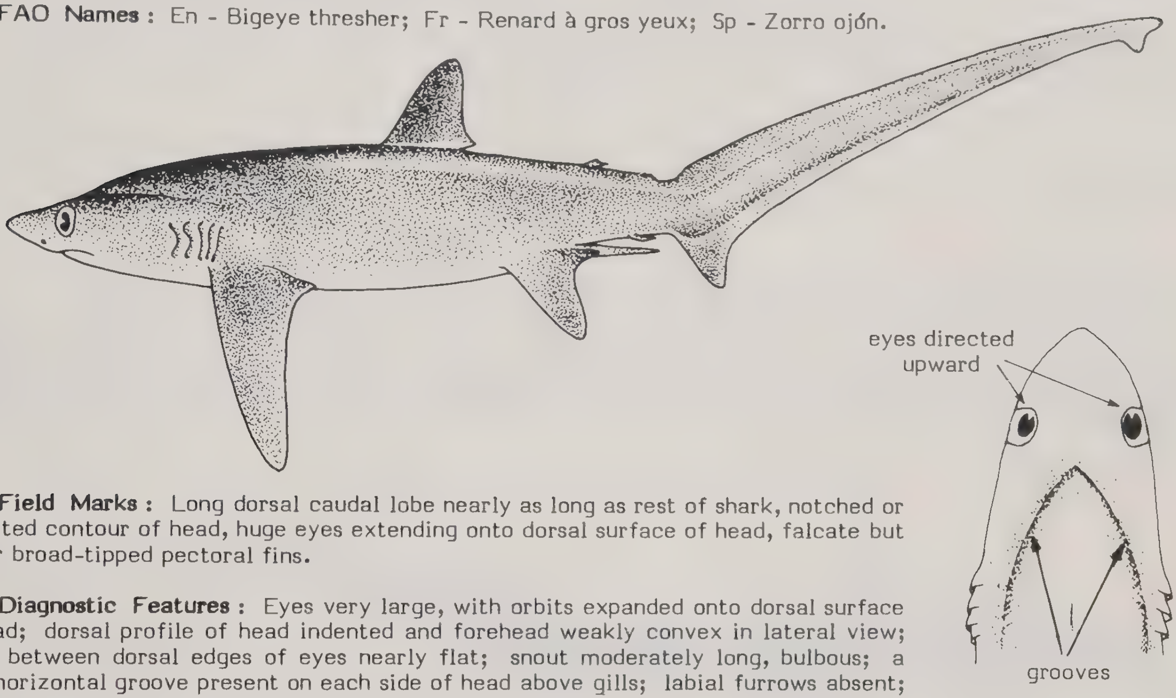
Alopias superciliosus (Lowe, 1839)

ALOP Alop 1

Alopecias superciliosus Lowe, 1839, Trans.Zool.Soc.London, 3(1):18. Holotype: Unknown. Type Locality: Madeira, eastern Atlantic.

Synonymy : Alopias profundus Nakamura, 1935.

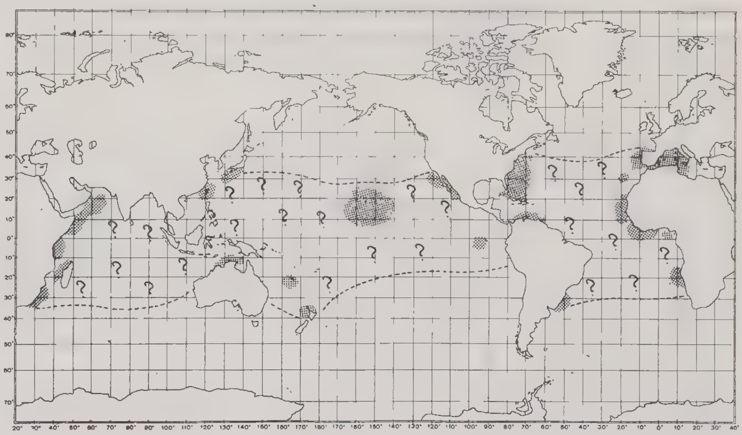
FAO Names : En - Bigeye thresher; Fr - Renard à gros yeux; Sp - Zorro ojón.



dorsal view of head

Field Marks : Long dorsal caudal lobe nearly as long as rest of shark, notched or helmeted contour of head, huge eyes extending onto dorsal surface of head, falcate but rather broad-tipped pectoral fins.

Diagnostic Features : Eyes very large, with orbits expanded onto dorsal surface of head; dorsal profile of head indented and forehead weakly convex in lateral view; space between dorsal edges of eyes nearly flat; snout moderately long, bulbous; a deep horizontal groove present on each side of head above gills; labial furrows absent; teeth moderately large, less than 25 rows in either jaw. Pectoral fins falcate with broad apices; terminal lobe of caudal fin moderately large. Light colour of abdomen not extending over pectoral fin bases.



Geographical Distribution : Oceanic and coastal, virtually circumtropical. Western Atlantic: New York to Florida (USA), Bahamas, Cuba, Venezuela, and southern Brazil. Eastern Atlantic: Portugal, Madeira, Senegal, Guinea to Sierra Leone, Angola; also Mediterranean Sea. Western Indian Ocean: South Africa, Madagascar, Arabian Sea. Western Pacific: Southern Japan, Taiwan (Province of China), New Caledonia, Australia (northwestern coast), New Zealand. Central Pacific: North and south of Hawaiian Islands. Eastern Pacific: Southern California, Gulf of California and west of Galapagos Islands.

Habitat and Biology : Found in coastal waters over the continental shelves, sometimes close inshore in shallow waters, and on the high seas far from land; sometimes caught near the bottom in deep water. Depths of occurrence range from the surface to at least 500 m.

An epipelagic, neritic, and epibenthic shark, apparently strong-swimming. Ovoviviparous, with uterine cannibalism, number of young usually 2 per litter, but sometimes up to 4. Feeds on pelagic (lancetfishes, clupeoids, scombroids, and small billfishes) and bottom fishes (hakes); also squids. Apparently stuns its prey with its long caudal fin, as individuals are often tail-hooked on longlines. Apparently harmless to people.

Size : Maximum total length about 461 cm, smallest adult male reported 270 cm and largest about 400 cm, smallest adult female about 355 cm and largest over 430 cm; size at birth between 64 to 106 cm, full term fetuses have been collected at 105 or 106 cm.

Interest to Fisheries : Generally caught in the oceanic longline fisheries operated by the USSR and Japan; especially important areas for these fisheries are the northwestern Indian ocean and the Central Pacific. The bigeye thresher is a very important component of the Cuban longline fishery, and has recently been taken in considerable numbers by longliners off the northeastern USA. The species is also taken in fixed bottom and pelagic gillnets, in trawls, and with sportsfishing gear (rod and reel). Its meat is utilized fresh, smoked and dried salted for human consumption, its liver oil is processed for vitamins, its skin for leather, and fins for shark-fin soup.

Literature : Bigelow & Schroeder (1948), Bass, d'Aubrey & Kistnasamy (1975b), Gruber & Compagno (1981); Gillmore (1983), who had two fetuses that were full-term at 105 to 106 cm total length.

Remarks : See Gruber & Compagno (1982) for a discussion of the synonymy of A. profundus with this species, and for a general review of the biology of A. superciliosus.

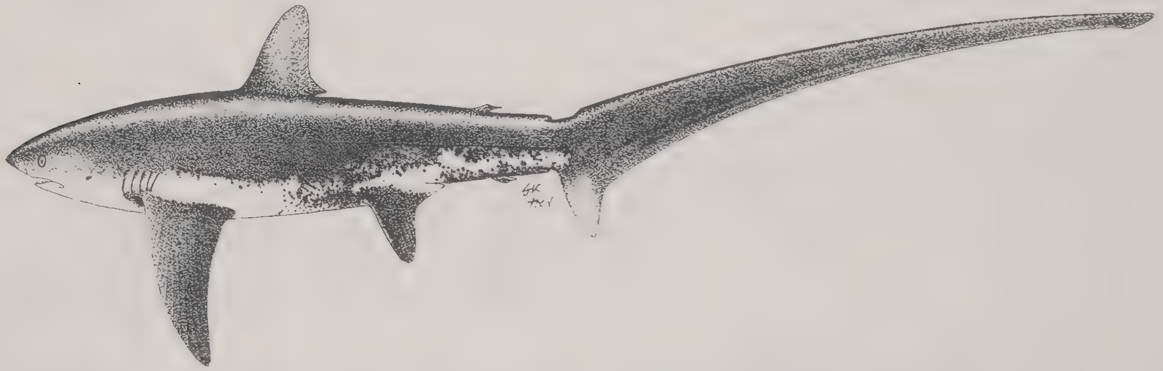
Alopias vulpinus (Bonnaterre, 1788)

ALOP Alop 2

Squalus vulpinus Bonnaterre, 1788, Tabl.Encyclop.Méthod. Trois Reg.Nat., Ichthyol., Paris, 9. Holotype: Unknown. Type Locality: Mediterranean Sea.

Synonymy : Squalus vulpes Gmelin, 1789; Alopias macrourus Rafinesque, 1810; Galeus vulpecula Rafinesque, 1810; Squalus alopecias Gronow in Gray, 1854; Alopecias barrae Perez Canto, 1886; Alopecias chilensis Philippi, 1901; Alopecias longimana Philippi, 1901; Vulpecula marina Garman, 1913; Alopias caudatus Phillipps, 1932; Alopias greyi Whitley, 1937.

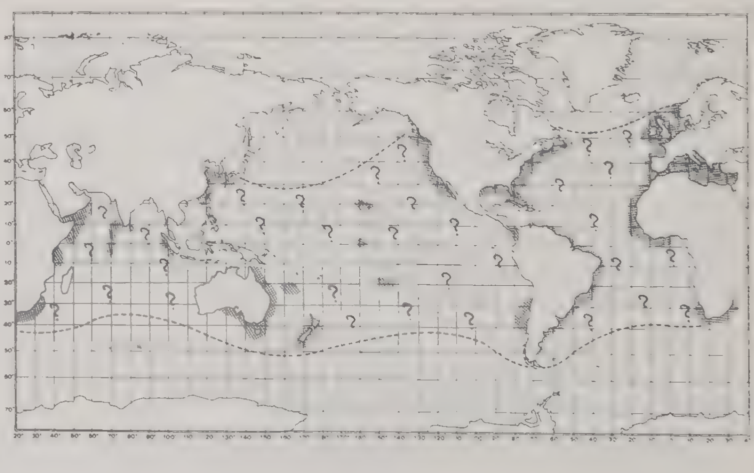
FAO Names : En - Thresher shark; Fr - Renard; Sp - Zorro.



Field Marks : Long curving dorsal caudal lobe about as long as rest of shark, relatively small eyes, falcate, pointed pectoral fins, white colour of abdomen extending over pectoral fin bases.

Diagnostic Features : Eyes moderately large at all sizes, orbits not expanded onto dorsal surface of head; dorsal profile of head convex and forehead strongly convex in lateral view; space between dorsal edges of eyes broadly convex; snout relatively short, conical and pointed; no grooves on head above gills; labial furrows present; teeth small, over 29 rows in either jaw. Pectoral fins falcate and narrow-tipped; terminal lobe of caudal fin moderately large. White colour of abdomen extending over pectoral fin bases as a conspicuous patch.

Geographical Distribution : Oceanic and coastal, virtually circumglobal in warm seas. Western Atlantic: Newfoundland to Cuba, Gulf of Mexico, Venezuela, Brazil to Argentina. Eastern Atlantic: Norway and British Isles to Mediterranean, Morocco, Ghana and Ivory Coast; also Cape Province, South Africa. Indo-West Pacific: South Africa, Tanzania, Somalia, Maldives, Chagos Archipelago, Gulf of Aden, Pakistan, India, Sri Lanka, Sumatra, Japan, Republic of Korea, China, Australia (Queensland, New South Wales, Victoria, Tasmania, South Australia), New Zealand, New Caledonia. Central Pacific: Society Islands, Fanning Islands, Hawaiian Islands. Eastern Pacific: British Columbia to central Baja California, Panama, Chile.



Habitat and Biology : Coastal over the continental and insular shelves and epipelagic far from land in temperate to tropical waters; young often close inshore and in shallow bays. Depth range from the surface to 366 m.

An active, strong-swimming shark, sometimes leaping out of the water. Populations in the northwestern Indian Ocean show spatial and depth segregation by sex. Ovoviviparous and apparently a uterine cannibal, number of young 2 to 4 in a litter (usually 2). Feeds mostly on small schooling fishes, including mackerels, bluefishes, clupeids, needlefishes, lancetfishes and lanternfishes; also squids, octopuses and pelagic crustaceans, and rarely seabirds. Herds and stuns its prey with its long, whiplike caudal fin, and is often caught on longlines by being tail-hooked. A few attacks on boats are doubtfully attributed to this species but it is otherwise apparently harmless to people, though the size of adults of this species should invite respect. There is an unconfirmed anecdotal account of a fisherman on the western North Atlantic coast of the USA that was decapitated by a tailstroke from a big adult thresher (Mundus & Wisner, 1971). Small specimens have been seen underwater by divers, at the surface or close to the bottom, and have circled them at the limit of visibility without acting aggressively.

Size : Maximum total length 549 cm and possibly to 609 cm, adult males 319 to at least 420 cm, adult females 376 to 549 cm; size at birth 114 to 150 cm.

Interest to Fisheries : Caught in the oceanic longline fisheries operated by the USSR and Japan; especially important areas for these fisheries are the northwestern Indian Ocean and the central Pacific, but the species is caught elsewhere on longlines. Also fished with anchored bottom and surface gillnets, floating gillnets and sportsfishing gear (rod and reel); the species has recently become the object of an important pelagic gillnet fishery off southern California. The meat is highly prized fresh for human consumption but is also eaten smoked and dried salted; the fins are valuable for shark-fin soup; the hide is usable for leather and the liver oil can be processed for vitamins.

Literature : Bigelow & Schroeder (1948), Bass, d'Aubrey & Kistnasamy (1975b).

8.6 FAMILY CETORHINIDAE Gill, 1862

CETOR

Subfamily Cetorhininae Gill, 1862 (Family Lamnoidae), Ann.Lyceum Nat.Hist.N.Y., 7(32):397-8.

Synonymy : Group Selachina Günther, 1870 (Family Lamnidae); Family Selachidae Poey, 1875; Family Halsydridae Whitley, 1934.

FAO Names : En - Basking sharks; Fr - Requins pélerin; Sp - Peregrinos.

Diagnostic Features : Trunk fusiform and moderately stout. Head moderately long but much shorter than trunk; snout moderately long, pointed and conical, not depressed, flattened and bladelike; eyes small; mouth large and arcuate, ventral on head, gill openings extremely large, extending onto dorsal and ventral surfaces of head, all anterior to pectoral fin bases; gillrakers present on internal gill slits, in the form of hairlike modified dermal denticles with extremely elongated crowns; teeth very small, hooklike, not blade-shaped, and in over 200 rows in either jaws; several rows of small anterior teeth in upper jaw, separated from the laterals by a broad gap. First dorsal fin large, high, erect and angular; second dorsal and anal fins moderately large but less than half size of first dorsal, with broad, non-pivotable bases; pectoral fins long and moderately broad, much shorter than head in adults; pelvic fins smaller than first dorsal fin but larger than second; caudal fin lunate, upper lobe moderately long but less than one-third length of rest of shark, lower lobe nearly as long as upper lobe. Precaudal pits present, caudal peduncle depressed and with strong lateral keels.

Remarks : This family has often been placed in synonymy of the family Lamnidae but, as noted by Springer & Gilbert (1976), is very distinct. Its relationship to the Lamnidae remains unclear.

Cetorhinus Blainville, 1816

CETOR Cetor

Genus : Subgenus Cetorhinus Blainville, 1816 (Genus Squalus Linnaeus, 1758), Bull.Sci.Soc.Philomat.Paris, (8):121.

Type Species : Squalus maximus "Linnaeus" (= Gmelin, 1789?), by subsequent designation of Gill (1862), a junior synonym of Squalus maximus Gunnerus, 1765.

Synonymy : Genus Halsydrus Neil, 1809 (nomen nudum); Fleming, 1817, 1822; ? Genus Tetroras Rafinesque, 1809; ? Genus Tetnoras Rafinesque, 1815 (error or emendation?); ? Genus Scoliophis Anon., 1817; Subgenus Selache Cuvier, 1817 (Genus Squalus Linnaeus, 1758); Genus Selanche Jarocki, 1822 (error ?); Genus Selachus Minding, 1832; Genus Ceteorhinus Agassiz, 1846 (error or emendation?); Genus Polyprosopus Couch, 1867; Genus Cethorhinus Escribano, 1909 (error ?); Genus Scapasaurus Marwick, 1942 (nomen nudum).

Remarks : Whitley (1934), followed by Fowler (1941) proposed that the genus Cetorhinus should be replaced by Halsydrus, which was based on the carcass of a 'sea monster' washed ashore in the Orkney Islands and eventually identified as a basking shark. According to Bland & Swinney (1978), Halsydrus as originally proposed was apparently a nomen nudum, separately proposed from descriptions of the Orkney 'monster', and does not comprise a senior synonym of Cetorhinus. The genus Tetroras (and its variant Tetnoras) is hard to identify from Rafinesque's (1809) generic description, with his claim that Tetroras has four gill openings being plainly erroneous. The description of Tetroras angiova, the only species in the genus, does indeed suggest a basking shark in certain details "denti in forma di raspa ... ha gli occhi piccolissimi, e le aperture delle branchie bastantemente larghe.". However, even if more evidence was available to prove that T. angiova actually was a basking shark, the substitution of Tetroras for Cetorhinus would not serve the stability of zoological nomenclature due to virtually universal usage of Cetorhinus for the genus of the basking shark at present.

Cetorhinus maximus (Gunnerus, 1765)

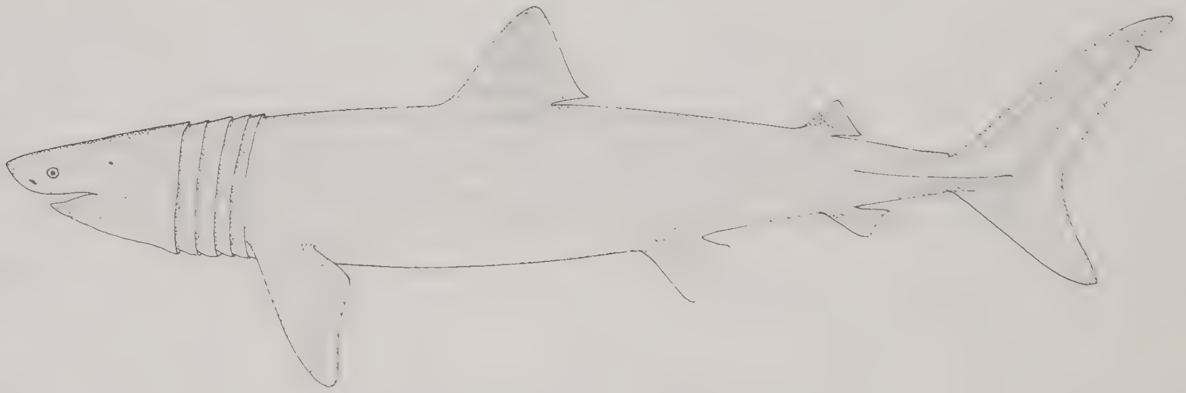
CETOR Cetor 1

Squalus maximus Gunnerus, 1765, K.norske Vidensk-selsk.Skr.Trondh., 33, pl. 2. Holotype: Apparently none. Type Locality: Trondhjem, Norway.

Synonymy : Halsydrus pontoppidani Neill, 1809 (nomen nudum), Fleming, 1817; ? Tetroras angiova Rafinesque, 1809; Squalus gunnerianus Blainville, 1810; Squalus homianus Blainville, 1810; Squalus pelegrinus Blainville, 1810; Squalus peregrinus Blainville, 1811; Squalus (Cetorhinus) gunneri Blainville, 1816; Squalus (Cetorhinus) shavianus Blainville, 1816; ? Scoliophis atlanticus Anon., 1817; Squalus isodus Macri, 1819; Squalus rostratus Macri, 1819; Squalus elephas LeSueur, 1822; Squalus rashleighanus Couch, 1838; Squalus rhinoceros Mitchell, in DeKey, 1842; Squalus cetaceus Gronow, 1854; Polyprosopus macer Couch, 1962; Cetorhinus blainvillei Brito Capello, 1870; Selachus pennantii Cornish, 1885; Cetorhinus maccoyi Barrett, 1933 (or Whitley and Phillipps, in Barrett ?); Cetorhinus maximus forma infanuncula Deinse & Adriani, 1953; Cetorhinus maximus normani Siccardi, 1960.

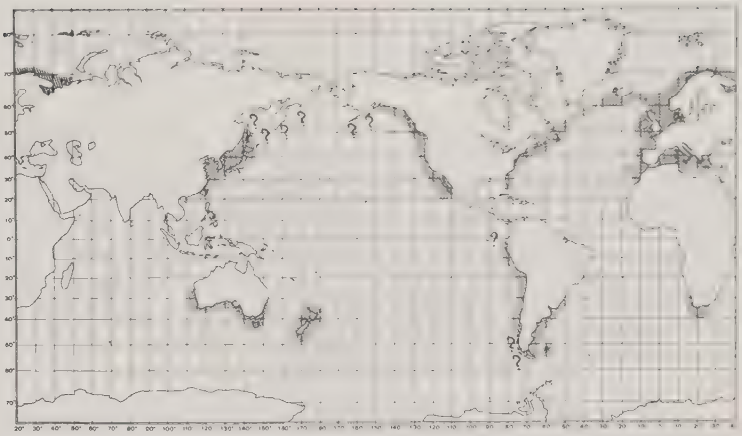
Other Scientific Names Recently in Use : Halsydrus maximus (Gunnerus, 1765); Halsydrus maccoyi (Barrett, 1933); Cetorhinus rostratus (Macri, 1819); Cetorhinus normani Siccardi, 1960.

FAO Names : En - Basking shark; Fr - Pélerin; Sp - Peregrino.



Field Marks : The great size, enormous gill slits that virtually incircle the head, dermal denticle gillrakers, pointed snout, huge, subterminal mouth with minute hooked teeth, caudal peduncle with strong lateral keels, and lunate caudal fin distinguish this shark from all others.

Diagnostic Features : See family.



Geographical Distribution : Coastal and amphitemperate. Western Atlantic: Newfoundland to Florida; southern Brazil to Argentina. Eastern Atlantic: Iceland, Norway and western Barents Sea to Mediterranean and Senegal; western Cape Province, South Africa. Western Indian Ocean: Eastern Cape Province, South Africa. Western Pacific: Japan, the Koreas, China; Australia (New South Wales, Victoria, Tasmania, South and Western Australia), New Zealand. Eastern Pacific: Gulf of Alaska to Gulf of California; Ecuador, Peru and Chile, ?Galapagos Islands.

Habitat and Biology : A coastal-pelagic shark found in boreal to warm temperate waters of the continental and insular shelves, occurring well offshore and often very close to land, just off the surf zone; enters enclosed bays. This huge, impressive, conspicuous shark is often seen at or near the surface, singly, in pairs, triads or in schools up to a hundred or more individuals, basking with dorsal fins out of the water or even with bellies upward, or moving slowly forward or in short arcs with their mouths open like hoops while feeding. Surface basking in this shark is thought to be correlated with surface concentrations of food plankton and also with courtship and mating. Two, three or more individuals may swim in tandem, in a straight line or in circles, which suggests to some writers that a row of these sharks swimming together may have been mistaken for a single huge 'sea serpent' in the past. Dead basking sharks are often stranded on a beach, in a state of advanced decay and damaged and partly dismembered from rolling in the surf; several times such carcasses have been misidentified as 'sea serpents' or other fabulous monsters.

Basking sharks have been reported as jumping out of the water, and it has been suggested that they do so to dislodge parasites or comensals like remoras. In addition to the ectoparasitic copepods found on other sharks, basking sharks often have sea lampreys attached to their skin, and although lampreys apparently are unable to cut through the formidable denticle-armored skin of the shark, they may be enough of an irritant to evoke a reaction like jumping or rubbing on objects or the bottom to dislodge them. However, some recent writers doubt that the basking shark can jump, due to its ordinarily slow cruising-speed of some 2 knots, and its reaction to harpooning by speeding up to only about 4 mph without jumping; according to this view, records of jumping in basking sharks result from mistaking leaping dolphins and thresher sharks for them.

The massive liver of the basking shark, contained in a long body cavity, apparently serves at a 'hepatic float' to adjust it to approximately neutral buoyancy.

Basking sharks are highly migratory, and noteworthy for their seasonal appearance in given localities and subsequent disappearance. Off the Atlantic seaboard of North America they appear in the southern part of their range in spring (North Carolina to New York), apparently shift northward in summer (New England, and Canada), and disappear in autumn and winter. Off the eastern North Pacific basking sharks occur in greatest numbers during autumn and winter in the southernmost part of their range there (California), but shift at least in part to more northern latitudes in spring and summer (up Washington and British Columbia). Off the British Isles the bulk of the population there appears in the springtime and disappears by autumn, but individuals may be present at all seasons of the year. Research is currently in progress in the eastern North Atlantic using long range radio tags attached to basking sharks and satellite tracking of the tags to resolve some of the problems of migration in this species. Individuals found off the British Isles in summertime are apparently engaged in courtship activity and copulation, as indicated by behavioural observations and courtship and mating scars found on captured individuals.

Pronounced spatial and seasonal populational segregation may be a characteristic of this species, as suggested by fisheries catches off the British Isles. Most individuals caught there in the summer were subadult, or nonpregnant adult females, outnumbering the males by 40:1, but in the winter the few individuals caught were mostly males. Pregnant females are almost entirely unknown for the species, suggesting that such females are spatially and bathymetrically separated from those members of the population that are regularly seen basking at the surface. Juveniles below 3 m long are also extremely rare, with a single record of a free-living individual about 1.7 m long reported from the British Isles.

Adult, nonpregnant female basking sharks have immense numbers of small eggs in their ovaries. Presumably this shark is ovoviviparous and has uterine cannibalism like other lamnoids, with embryos feeding on the small eggs and possibly smaller siblings, but this remains to be seen. An unconfirmed record of a fetus about 1.7 m long and the above mentioned free-living individual suggests that size at birth may be about 1.7 m, and hence greater than any other known ovoviviparous or viviparous shark.

Age of this shark has been estimated by counting vertebral rings and attempting to correlate them with supposed changes in size of individuals within a population. It has been suggested that birth occurs after 3 and 1/2 year gestation period, and that two calcified rings per year are laid down until maturity at between 6 or 7 years for males. The biannually calibration of the rings is uncertain and controversial; a yearly rate of ring deposition has been suggested, with possible age at maturity for males doubled to 12 to 16 or more years. Whatever the case, the basking shark has proved to be extremely vulnerable to overfishing, perhaps more so than most sharks, and this can be ascribed to its slow growth rate, lengthy maturation time, long gestation period, probably low fecundity, and probable small size of existing populations (belied by the immense size of individuals in their small schools).

The basking shark is one of the three types of huge, filter-feeding sharks, the other two being the megamouth and whale sharks. The basking shark may be unique in relying entirely on the passive flow of water through its pharynx generated by swimming for filtration; the other two giant filter-feeders may assist the process of food ingestion by actively pumping or gulping water and food organisms into their pharynxes. The basking shark feeds exclusively on small planktonic organisms trapped on its unique gillrakers, apparently with the help of mucous secreted in its pharynx. Food items include small copepods, barnacles, decapod larvae, and fish eggs. On the average, a half ton of material may be present in the stomach of these sharks. While feeding the basking shark cruises with mouth widely open and gills distended, occasionally closing its mouth to ingest its prey. An average adult has been estimated to be capable of filtering over 2000 tons of water per hour assuming a constant cruising speed of about 2 knots.

The facts that the basking shark periodically sheds its gillrakers and that plankton densities seasonally fall below levels thought essential to maintain ordinary swimming and metabolic activity in this shark have spawned a controversy over whether or not the species remains active when deprived of gillrakers and high plankton densities. It has been suggested that the basking shark may 'hybernate' on the bottom, perhaps at the edge of continental shelves, until its rakers are replaced and plankton blooms reoccur. Proof of hybernation has never been forthcoming, and an alternate hypothesis has been suggested that the basking shark may turn to benthic feeding when it loses its gillrakers. A possible additional factor is that the massive oil-filled liver of this species may serve as a metabolic store to supply energy to support a reduced rate of activity (slower swimming in colder, deep water) while gillrakers and plankton supplies regenerate. Estimates have been proposed that, in north European waters, the basking shark drops its gillrakers in early winter and takes about 4 or 5 months to fully replace them.

The basking shark is usually quite tolerant of boats approaching closely to it (to its detriment when harpoon fisheries for it have been mounted), and divers have been able to swim right up to individuals and photograph them without invoking an extreme fright reaction. Basking sharks may approach divers quite closely, possibly out of curiosity, and swim around them. This species is regarded as ordinarily harmless and inoffensive but potentially dangerous if attacked (particularly when harpooned). The immense size and power of the basking shark should invite respect, however. Divers should avoid contact with the skin of this shark, which has large dermal denticles with sharp, hooked crowns that point forward and sideways as well as backward; while involved in the dissection of a large basking shark the writer has experienced first hand the lacerations that can result from contact with its skin.

Size : Basking sharks have been credited as reaching a maximum total length of 12.2 to 15.2 m, but even if this is correct most specimens do not exceed about 9.8 m. Males mature at about 4 or 5 m and reach about 9 m, females are mature at 8.1 to 9.8 m. Size at birth unknown; the smallest known free-living individual was 165 cm long. The basking shark is the second largest shark, fish-like vertebrate, and elasmobranch after the whale shark (Rhiniodon typus).

Interest to Fisheries : The basking shark has been the object of smallscale harpoon fisheries from small boats off the Norwegian coast, Ireland and Scotland, Iceland, California, Peru and Ecuador, often sporadically fished due to periodic depletion of basking shark stocks; during the last century they were also harpooned by whaling vessels. Currently they are being heavily fished off China and Japan by harpoon. The basking shark has also been taken in nets, including bottom gillnets and even bottom and pelagic trawls, and sometimes is a problem to salmon gillnetters in the Pacific northwest of North America by fouling gillnets. The basking shark meat is used for human consumption fresh or dried salted; its fins are used for shark-fin soup; its liver, rich in oil and very large, is extracted for its high squalene content but the liver oil was formerly used for tanning leather for lamp oil; the hide for leather; and the carcass for fishmeal.

Literature : Bigelow & Schroeder (1948); Matthews (1950); Matthews & Parker (1950); Van Deinse & Adriani (1953); Parker & Boeseman (1954); Matthews (1956); Siccardi (1961); Parker & Stott (1965); Squire (1967); Springer & Gilbert (1976); Davis (1983); D. Pauly (1983, pers.comm.).

Remarks : Siccardi (1960, 1961) suggested that there are four species of Cetorhinus, two from the North Atlantic and Mediterranean (C. maximus and C. rostratus), one from southern Australia (C. maccoyi) and one from the South Atlantic (C. normani). Pending further work, I prefer to follow Springer & Gilbert's (1976) reasoning that there is insufficient evidence at present to separate these species.

8.7 FAMILY LAMNIDAE Müller & Henle, 1838

LAMN

Family Lamnoidea Müller & Henle, 1838, Ann.Mag.Nat.Hist., 2:36.

Synonymy : Subfamily Lamnini Bonaparte, 1838 (Family Squalidae); Tribe Isurina Gray, 1815 (Family Squalidae); Subfamily Carcharodontinae Gill, 1893 (Family Isuridae); Family Lamiostomatidae Glikman, 1964.

FAO Names : En - Mackerel sharks, Porbeagles, White sharks; Fr - Requins taupe; Sp - Jaquetones, Marrajos.

Field Marks : Large sharks with pointed snouts and spindle-shaped bodies, long mouths with large, bladelike teeth, long gill slits, long pectoral fins and high first dorsal fins, small, pivoting second dorsal and anal fins, large lateral keels and prominent precaudal pits on the caudal peduncle, and lunate caudal fins.

Diagnostic Features : Trunk fusiform and moderately slender to very stout. Head moderately long but shorter than trunk; snout moderately long, pointed and conical, not greatly elongated, flattened and bladelike; eyes moderately large; mouth large, ventral on head, gill openings large, extending onto dorsal surface of head, all anterior to pectoral fin bases; no gillrakers on internal gill slits; teeth large, anteriors and laterals narrow and awl or bladelike to broad, compressed and triangular, less than 85 rows in either jaw; two rows of large anterior teeth in each jaw, the uppers separated from the upper lateral teeth by one row of small intermediate teeth on each side. First dorsal fin large, high, erect and angular or somewhat rounded; second dorsal and anal fins minute, much smaller than first dorsal fin, with narrows pivoting bases; pectoral fins very long and narrow, shorter to about as long as head in adults; pelvic fins small, much smaller than first dorsal fin but larger than second dorsal and anal fins; caudal fin lunate, upper lobe moderately long, less than one third as long as rest of shark, lower lobe long and strong, nearly as long as upper lobe. Precaudal pits present, caudal peduncle strongly depressed and with strong, high keels.

Habitat, Distribution and Biology : Lamnids are tropical to cold-temperate, littoral to epipelagic sharks with a broad geographic distribution in virtually all seas, in continental and insular waters from the surf line to the outer shelves and rarely down the slopes to at least 1280 m. All the living species are of large size, with a maximum length of 3 to at least 6.4 m; a giant, rather recently (late Pliocene) extinct member of the white shark genus (Carcharodon megalodon) attained as estimated length of about 12.4 m.

These sharks are fast-swimming, active pelagic and epibenthic swimmers, some of which are capable of swift dashes and spectacular jumps when chasing their prey. Mackerel sharks are partially warm-blooded, and have a modified circulatory system that enables them to retain a body temperature warmer than the surrounding water. This permits a higher level of activity and increases the power of their muscles. They feed on a wide variety of bony fishes, other sharks, rays, marine birds and reptiles, marine mammals, squids, bottom crustaceans, and carrion. Development is ovoviviparous, without a yolk-sac placenta. Like other lamnoid sharks where reproduction is known these sharks have oophagy or uterine cannibalism, in which developing fetuses feed on fertilized eggs and possibly smaller siblings for a long time before birth.

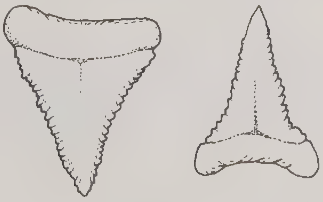
Lamnids of the genus Lamna are apparently inoffensive but are considered potentially dangerous to people because of their size and relatively large teeth. At least one member of the genus Isurus (shortfin mako) has been indicted in a few attacks on swimmers and divers, but has attacked boats several times; the other species (longfin mako) has never been recorded as attacking people or boats. However, this family contains what is generally considered the most dangerous shark, the great white (Carcharodon), because of numerous attacks by it on swimmers, divers, surfers and boats.

Interest to Fisheries : These sharks are important objects of fisheries because of their fine meat, but are also utilized for oil, fins, hides, fishmeal, jaws and teeth. Some species are oceanic in whole or part, and are mainly taken with pelagic longlines; gillnets, hook-and-line, and even harpoons, pelagic and bottom trawls are used to capture these sharks.

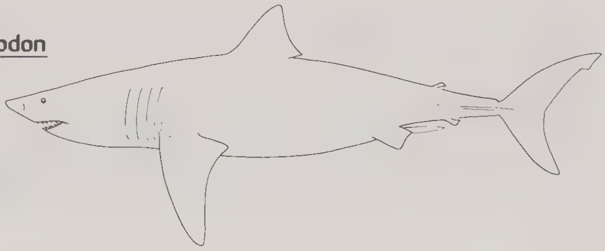
Remarks : Reviews of this family are in Bigelow & Schroeder (1948), Garrick & Schultz (1963), Farquhar (1963), and Bass, d'Aubrey & Kistnasamy (1975b).

Key to Genera :

1a. Teeth serrated, uppers flat and with broadly triangular cusps (Fig. 1) .... **Carcharodon**



upper and lower tooth



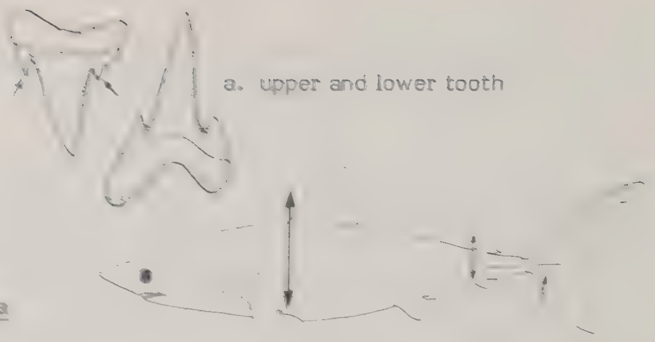
Carcharodon

Fig.1

2b. Teeth smooth-edged, cusps not greatly flattened and with narrowly triangular cusps (Figs 2a, 3a)

3a. Lateral cusplets present on most teeth (sometimes absent in young) (Fig. 2a). Origin of first dorsal fin over or anterior to inner margins of pectorals; origin of second dorsal over origin of anal fin. A secondary keel present below main keel on caudal fin (Fig. 2b) .... Lamna

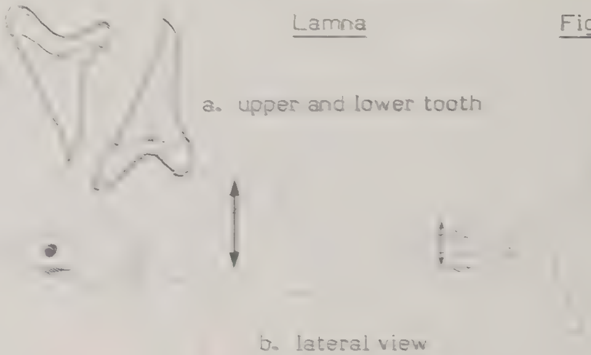
3b. No cusplets on teeth (Fig. 3a). Origin of first dorsal fin over or behind rear tips of pectorals; origin of second dorsal well in front of anal fin origin. No secondary keel on caudal fin (Fig. 3b) .... Isurus



a. upper and lower tooth

b. lateral view

Lamna Fig.2



a. upper and lower tooth

b. lateral view

Isurus Fig.3

Carcharodon Smith, 1838

LAMN Car

Genus: Carcharodon Smith, in Müller & Henle, 1838, Ann.Mag.Nat.Hist., 2:37. Placed on Official List of Generic Names in Zoology (Name no. 1658) by the International Commission on Zoological Nomenclature, Opinion 723.3a, 1965.

Type Species: Squalus carcharias Linnaeus, 1758, by subsequent monotypy through Carcharias lamia Rafinesque, 1810. International Commission on Zoological Nomenclature, Opinion 723.3b, 1965, p. 32.

Synonymy: None.

Diagnostic Features: Body usually stout. Snout bluntly conical, rather short; nostrils lateral on snout, situated adjacent to head rim in ventral view; mouth broadly parabolic; teeth flat, tirangular, with broad, serrated, nearly straight cusps and lateral cusplets absent in specimens below 2 m long (which may have at least some smooth-edged or partially serrated); intermediate teeth in upper jaw very large, over half height of upper anteriors. First dorsal origin usually over the pectoral inner margins; anal origin under or slightly posterior to second dorsal insertion; no secondary keels on base of caudal.

Remarks: See White, Tucker & Marshall (1961), and the International Commission on Zoological Nomenclature (1965) for the nomenclatural history of this genus.

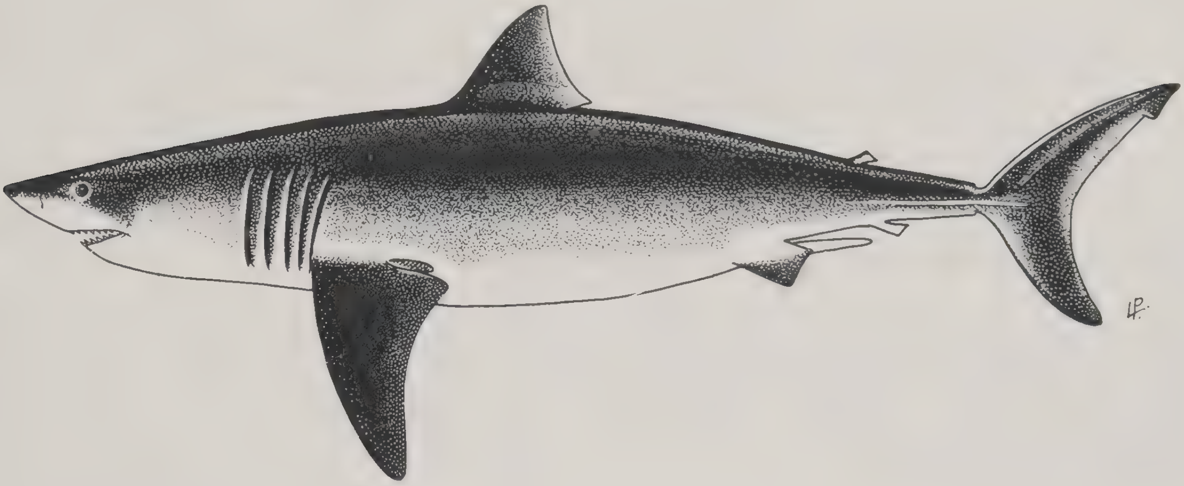
Carcharodon carcharias (Linnaeus, 1758)

LAMN Car 1

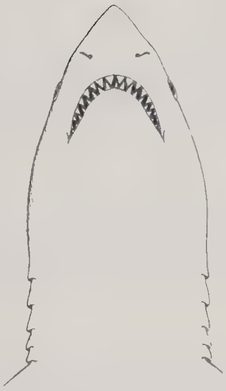
Squalus carcharias Linnaeus, 1758, Syst.Nat., ed. 10, 1:235. Placed on the Official List of Specific Names in Zoology (Name no. 1706) by the International Commission on Zoological Nomenclature, Opinion 723.4a, 1965. Holotype: Unknown. Type Locality: "Europa".

Synonymy: Carcharias lamia Rafinesque, 1810; Carcharias verus Cloquet, 1822; Carcharias rondeletti Bory de St. Vincent, 1829; Squalus (Carcharias) vulgaris Richardson, 1836; Carcharodon smithii Agassiz, 1838 or Bonaparte, 1838; Carcharias atwoodi Storer, 1848; Carcharodon capensis Smith, 1849; ? Carcharias vorax Owen, 1853; Carcharias maso Norman, 1939 not Squalus (Carcharias) maou Lesson, 1830; Carcharodon albimors Whitley, 1939.

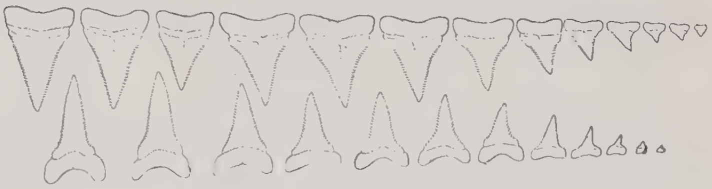
FAO Names : En - Great white shark; Fr - Grand requin blanc; Sp - Jaquetón blanco.



Field Marks : Heavy spindle-shaped body, moderately long conical snout, huge, flat, triangular, serrated bladelike teeth, long gill slits, large first dorsal fin with light free rear tip, minute, pivoting second dorsal and anal fins, strong keels on caudal peduncle, no secondary keels on caudal base, crescentic caudal fin, ventral surface on body white.



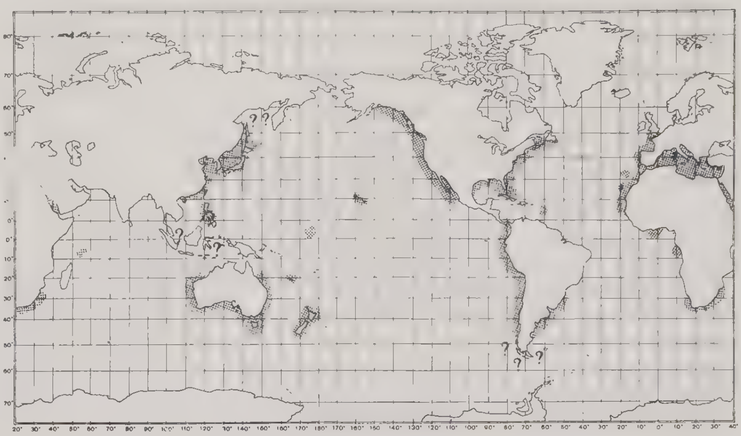
underside of head



upper and lower teeth from left side

Diagnostic Features : See genus.

Geographical Distribution : Coastal and mostly amphitemperate. Western Atlantic: Newfoundland to Florida, Bahamas, Cuba, northern Gulf of Mexico; Brazil and Argentina. Eastern Atlantic: France to Mediterranean, Madeira, Canary Islands, Senegal, Ghana, Zaire; Western Cape Province, South Africa. Western Indian Ocean: South Africa, Seychelles Islands, Red Sea. Western Pacific: Siberia (USSR), Japan, the Koreas, China, Bonin Island, the Philippines; ?Indonesia, Australia (Queensland, New South Wales, Victoria, Tasmania, South and Western Australia), New Zealand, New Caledonia. Central Pacific: Marshall Islands, Hawaiian Islands. Eastern Pacific: Gulf of Alaska to Gulf of California; Panama to Chile.



Habitat and Biology : This huge, fearsome shark is primarily a coastal and offshore inhabitant of the continental and insular shelves. The occurrence of large individuals off oceanic islands far from land where breeding populations of the species apparently do not exist suggests that it can and does make occasional epipelagic excursions into the ocean basins, even though it has never been taken in longline catches there (unlike its relatives in the genera Isurus and Lamna). The great white shark often occurs close inshore to the surfline and even penetrates shallow bays in continental coastal waters, but also prefers offshore continental islands (especially those with pinniped colonies). The white shark can be found at the surface down to the bottom in epicontinental waters but occasionally ranges down the continental slope, where it was once caught on a bottom longline at 1280 m along with the large sixgill shark (Hexanchus griseus).

This species is a very active shark with a stiff, powerful, scombroid-like mode of swimming that allows it to efficiently cruise for long periods at relatively slow speed. A recent offshore tracking attempt on a large shark with sonic tags indicated that it moved 190 km in 2.5 days at an average cruising speed of 3.2 kph. The white shark is capable of sudden high speed dashes and sometimes jumps right out of the water.

Records of the great white shark are commonest from cold and warm temperate areas, though there are enough tropical continental and oceanic records to suggest that at least larger individuals have a wide temperature range and penetrate at will into the tropical stronghold of carcharhinid sharks. Smaller individuals, below 3 m long, may be restricted to temperate seas, and the occurrence of presumably newborn individuals in the 120 to 130 cm size range suggest the pupping grounds for the species are also in temperate waters.

Relatively little is known of the abundance of this species, except that it is relatively uncommon compared to most other sharks where it lives. Catches in some areas may be as many as 47 per year (Natal, South Africa), but mostly less in others. Unfounded claims have been made that the species is increasing in numbers in some areas (off central California, for example), as a result of increasing numbers of pinnipeds, but there is no evidence to prove this, and increasing fishing pressure in such areas may be very well having the reverse effect.

Pronounced periodicity in white shark abundance may occur in some areas, apparently correlated with temperature and to some extent with life stage. In colder, higher latitudes at the periphery of its range in North America, the white shark moves into more northern areas when water masses warm up in the summertime; conversely, off Natal, South Africa, smaller individuals below 2.8 m long move in the area with a drop in water temperature below 22°C, and apparently depart for colder Cape Coast waters when temperatures rise above this level; however, larger individuals above 2.8 m seem to occur there all year round. In central California (Monterey Bay) white sharks are present year round but are slightly commoner when water temperatures rise to 14 or 15°C from below 11°C.

The white shark often occurs singly or in pairs but can be found at food sources in feeding aggregations of 10 or more; schooling apparently does not occur. Behaviour of this species is poorly known, but there is anecdotal evidence to suggest that recognizable individuals may seasonally revisit a favoured site for several years. Territoriality in the white shark cannot be demonstrated at present, but there is some evidence for sorting of individuals into a size-related hierarchy around food sources such as dead whales, pinniped colonies or feeding stations provided by people. Tooth scratches on individuals, including immature females and males, have been interpreted as evidence of intraspecific conflict, possibly in competition for food resources. In certain areas (southern Australia and central California), white sharks may have habituated to human-provided food sources such as fishing boats and feeding stations (to lure white sharks in for photography and profits), and may have learned to come to these places to the delight or dispair of the humans involved (the latter if the sharks steal fish from lines).

Presumably the white shark is ovoviviparous and practices uterine cannibalism as do other lamnoids, but this is uncertain because pregnant females of this species are almost never reported. A litter of 9 young was reported from a Mediterranean female, unfortunately without further details. The rarity of pregnant females may be explained by spatial separation from other white sharks during pregnancy; their sheer size that precludes capture by most fishing gear; and by possibly very low fecundity, with relatively few adult females being pregnant at any one time.

The great white shark is a true superpredator and perhaps the most formidable of fishlike vertebrates. The combination of large size, very powerful jaws and teeth, and a relatively efficient locomotion and metabolism allows it to be a versatile predator with a broad prey spectrum. It also readily scavenges on available carrion, garbage, and secondary kills of fish caught on lines. Prey of the white shark includes a wide range of bony fishes, such as sturgeon, menhaden and pilchards, salmon, hake, halibut, rockfish, cabezon, lingcod, croakers, mackerels and tunas. Chondrichthyian prey includes other sharks such as houndsharks (Galeorhinus, Mustelus), requiem sharks (Carcharhinus, Rhizoprionodon), hammerheads (Sphyrna), and spiny dogfish (Squalus); also stingrays, eagle rays (Myliobatis), and chimaeras. Basking shark (Cetorhinus) meat has been found in several white sharks, apparently taken as carrion from harpooned sharks; it is presently unknown if the white shark ever attacks free-swimming basking sharks. Sea turtles are occasionally taken by the white shark, but apparently not to the degree that the tiger shark (Galeocerdo) preys on them. Birds are uncommonly taken by white sharks and include gannets, gulls, and penguins, but it is uncertain if these items were taken alive. Marine mammals are an important food source for large white sharks, and those killed and eaten include harbour porpoises, dolphins, and a number of pinnipeds such as harbour seals, northern elephant seals, Steller's and California sea lions, South African fur seals, and probably several other species. Sea otters are commonly killed by white sharks off California, but have yet to be found as stomach contents. Dead baleen whales and other large cetaceans may contribute a significant amount to the white shark's diet in some areas; mammalian carrion from slaughterhouses and other sources, including mutton, pig, horse, dog, and rarely human, has been found in the white shark's stomach also. Invertebrate prey includes squids, abalones and other gastropods, and crabs. Inedible garbage is occasionally taken from the stomachs of white sharks, but apparently this species is not fond of swallowing oddities like the tiger shark. Larger white sharks above 3 m long tend to prey heavily on marine mammals, while smaller sharks below 2 m long feed heavily on bony fishes and small sharks, but even large sharks are capable of eating smaller prey such as the 150 crabs, salmons, hakes, and rockfishes found in a 4.4 m specimen from Washington State, USA. Pinnipeds may be especially important prey for white sharks where they occur together, but in tropical areas without these mammals the white shark is probably capable of subsisting on other sharks, bony fishes, turtles and cetaceans.

The great white shark is feared by many people as the most dangerous living shark; more attacks on swimmers, divers surfers, and boats have been reported for this shark than for any others. It must be remembered, however, that some 80% of the reported shark attacks have occurred in the tropics, where white sharks are rare but where large, dangerous carcharhinid sharks predominate. Tropical carcharhinids, with some exceptions, are difficult to identify in the water, and the ratio of positive identifications of species of these sharks involved in attacks to numbers of tropical shark attacks is very low. In contrast, white sharks are readily identified as the species involved in temperate water shark attacks, probably in part because of the distinctive features of this shark, because of high popular interest in shark attack and the white shark in areas where the attacks occur, and because the white shark may be the only shark that regularly attacks people in these areas (in the tropics, several dangerous species of carcharhinids may occur in a given area). Therefore there might very well be tropical carcharhinids, particularly the tiger and bull sharks, that may be equally dangerous or more dangerous than the white shark, but this remains to be seen.

Although much has been made of white shark attacks in the popular newsmedia, the attack rate is very low, far less than drownings, diving accident, automobile accidents, lightning strokes, or other calamities that afflict humans in the countries where white shark attacks occur. Most white shark attacks have occurred off California (USA), southern Australia, New Zealand, and South Africa. Off north-central California, where the highest rate of white shark attacks is currently known, approximately 41 attacks attributable to these sharks occurred in the 32 year period from 1950 to 1982, averaging 1.3 per year and at a slightly higher rate (about 1.9 per year) at the end of the period than the beginning (about 0.7 per year). Only 4 of these attacks were fatal (0.12 per year); the rest resulted in minor or serious injuries to the people involved. Much speculation has occurred on the behaviour of white sharks in such attacks. The white shark is clearly capable of inflicting mortal wounds with a single bite, but often merely clamps onto its human victims without completing its bite and releases them after a short time. Such behaviour has been interpreted as non-feeding aggression toward people, but also as 'mistaken identity' feeding attacks, in which the shark bites its victim after mistaking it for a seal or other normal prey and then aborts its attack. Another possibility is that such attacks are exploratory 'sampling' of a potential food item, with subsequent rejection. Displacement behaviour and even 'play' are other hypotheses that could be evoked. Full-fledged feeding attacks in which the white shark repeatedly bites and dismembers its human victim have been reported, but fortunately these are extremely rare compared to abortive attacks (the various "JAWS" movies not withstanding).

In recent years several surfers and paddleboarders have been attacked by white sharks, which have sometimes destroyed their boards. Boats may be attacked, particularly if a feeding stimulus like fish catches is involved. For some reason False Bay, South Africa, is the site of more boat attacks by white sharks than all other places combined. White sharks have on a few occasions persistantly attacked boats until they sank, and in at least one instance lept into a boat.

Despite the frightful reputation of the great white shark there is accumulating evidence that, especially for SCUBA divers, the presence of a white shark near people does not necessarily mean that an attack is inevitable. Increasing numbers of cases have been reported where these sharks swim up to divers as close as a few feet and depart without attacking. From the white shark's viewpoint human beings are much more dangerous to it than vice-versa. Off California 10 to 20 or more white sharks are killed each year as a bycatch of fisheries, vs. 0.13 humans per year killed by white sharks. As the number of white sharks present in these waters is very small and probably vastly less than the heard of swimmers, divers, surfers, and other people at risk from white shark attack, the sharks are sustaining a greatly higher per capita loss from human attack than people are from them.

Size : Maximum total length at least 640 cm and possibly to over 800 cm. Individuals captured are more commonly between 140 and 600 cm. Some males may begin maturing at about 240 cm, but adult males may reach about 550 cm.

A length-weight power curve for the white shark (98 specimens, mostly from California, and with a total length range from 127 to 554 cm) is as follows:

$$WT = 4.34 \times 10^{-6} TL^{3.14}$$

Interest to Fisheries : Limited, as this species is nowhere abundant enough to support a significant fishery; mostly taken as a bycatch of fisheries of other sharks and other fishes, by longlines, hook-and-line, fixed bottom gillnets, fish traps, herring weirs, and trammel nets, harpoons, and even bottom and pelagic trawls, as well as purse seines. Important as a big-game sports fish in a few areas, especially Australia and the northeastern United Stated. Utilized fresh, dried salted, and smoked for human consumption; the liver oil is extracted for vitamins; the carcass used for fishmeal; the skin for leather; the fins for shark-fin soup; and the teeth and jaws for decorations, with properly prepared large jaws bringing a high price.

Literature : Whitley (1940); Fowler (1941); Biegelow & Schroeder (1948); Strasberg (1958); Farquhar (1963); Garrick & Schultz (1963); Limbaugh (1963); Stead (1963); Squire (1967); Arnold (1971); Mundus & Wisner (1971); Randall (1973); Bass, d'Aubrey & Kistnasamy (1975b); Ellis (1975); Wallett (1978); Ames & Morejohn (1980); Ainley et al. (1981); Miller & Collier (1981); Carey et al. (1982); Le Bouf, Riedmann & Keys (1982); Pratt, Casey & Conklin (1982); David Allen (pers.comm.); Bob Lea (pers.comm.); Gregor Cailliet (pers.comm.); A. Peter Klimley (pers.comm.); David Ainley (pers.comm.); George Zorzi (pers.comm.); Susan Smith (pers.comm.); Raymond Keyes (pers.comm.).

Isurus Rafinesque, 1810

LAMN Isur

Genus : _Isurus_ Rafinesque, 1809, _Caratt.gen.sp.anim.piant.Sicilia, Palermo_, pt. 1:11.

Type Species : _Isurus oxyrinchus_ Rafinesque, 1809, by monotypy.

Synonymy : Genus _Oxyrhina_ Agassiz, 1835; Genus _Oxyrrhina_ Bonaparte, 1846 (emendation ?); Genus _Plectrostoma_ Gistel, 1848; Genus _Isuropsis_ Gill, 1862; Genus _Plectrosoma_ Bigelow & Schroeder, 1948 (error); Genus _Lamiostoma_ Glikman, 1964.

Diagnostic Features : Body usually fairly slender. Snout bluntly to acutely conical, rather long; nostrils lateral on snout, situated adjacent to head rim in ventral view; mouth narrowly parabolic; teeth narrow and thick, awl or blade-shaped, with narrow, smooth-edged, more or less flexed cusps and no lateral cusplets; intermediate teeth in upper jaw small, about half height of upper anteriors. First dorsal origin usually behind the pectoral free rear tips; anal origin under or slightly posterior to second dorsal insertion; no secondary keels on base of caudal fin.

Remarks : The arrangement of the genus _Isurus_ follows the revisions by Guitart Manday (1966) and Garrick (1967).

Key to Species :

1a. Snout usually acutely pointed. Cusps of upper and lower anterior teeth recurved lingually at bases but with tips reversed and curved labially. Pectoral fins considerably shorter than head, relatively narrow-tipped in young and acutely pointed in adults. Origin of anal fin about under midbase of second dorsal fin. Underside of snout and mouth white .... **_I. oxyrinchus_**

1b. Snout narrowly to bluntly pointed, usually not acute. Cusps of upper and lower anterior teeth straighter, with tips not reversed. Pectoral fins about as long as head, relatively broad-tipped in young and adults. Origin of anal fin about under insertion of second dorsal fin. Underside of snout and mouth dusky .... **_I. paucus_**

Isurus oxyrinchus Rafinesque, 1809

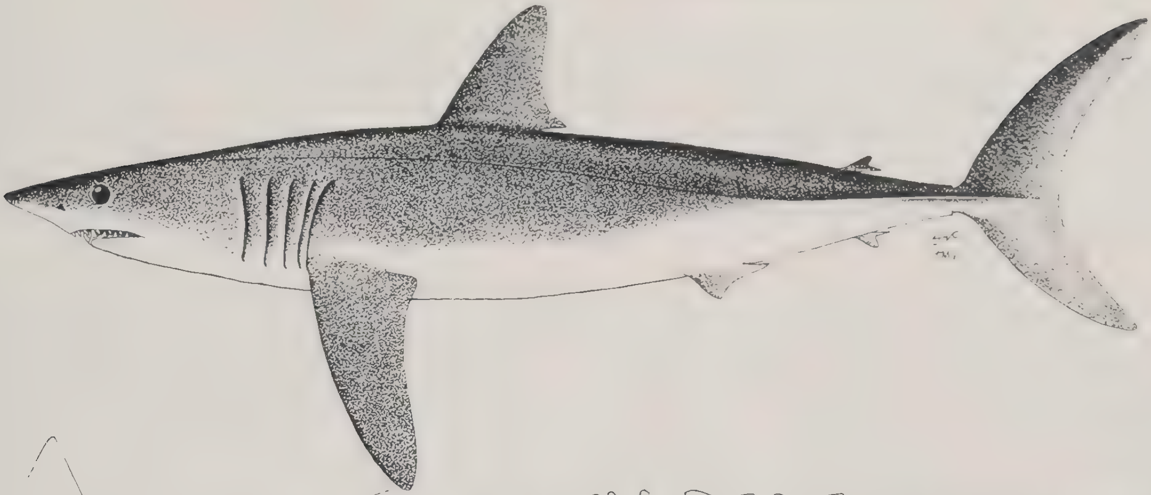
LAMN Isur 1

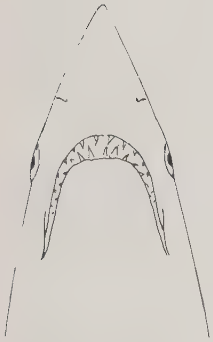
Isurus oxyrinchus Rafinesque, 1809, _Caratt.gen.sp.anim.pinat.Sicilia, Palermo_, pt. 1:12, pl. 12, fig. 1. Holotype: Unknown. Type Locality: Sicily, Mediterranean Sea.

Synonymy : _Isurus spallanzanii_ Rafinesque, 1810; _Squalus_ (_Lamna_) _cepedii_ Lesson, 1830; _Lamna oxyrhina_ Cuvier & Valenciennes, _in_ Agassiz, 1838; _Oxyrhina gomphodon_ Müller & Henle, 1839; _Oxyrhina glauca_ Müller & Henle, 1839; _Lamna punctata_ DeKey, 1842 (not _L. punctata_ Storer, 1839, = _L. nasus_); ? _Lamna latro_ Owen, 1853; _Isuropsis dekayi_ Gill, 1862 (not _Oxyrhina daekayi_ Gill, 1862 = _L. nasus_); _Carcharias tigris_ Atwood, 1865; _Lamna guentheri_ Murray, 1884; _Lamna huidobrii_ Philippi, 1887; _Isurus mako_ Whitley, 1929; _Isurus bideni_ Phillipps, 1932; _Isurus tigris africanus_ Smith, 1957.

Other Scientific Names Recently in Use : _Isurus glaucus_ (Müller & Henle, 1839).

FAO Names : En - Shortfin mako; Fr - Taupe bleu; Sp - Marrajo dientuso.





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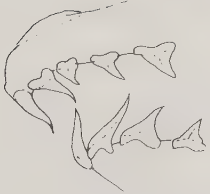
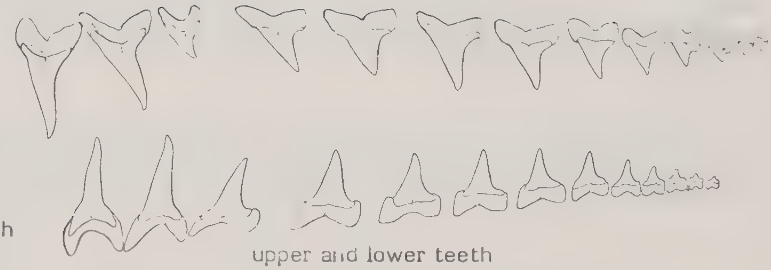


upper and lower teeth
in natural position
at tip of mouth
lateral view

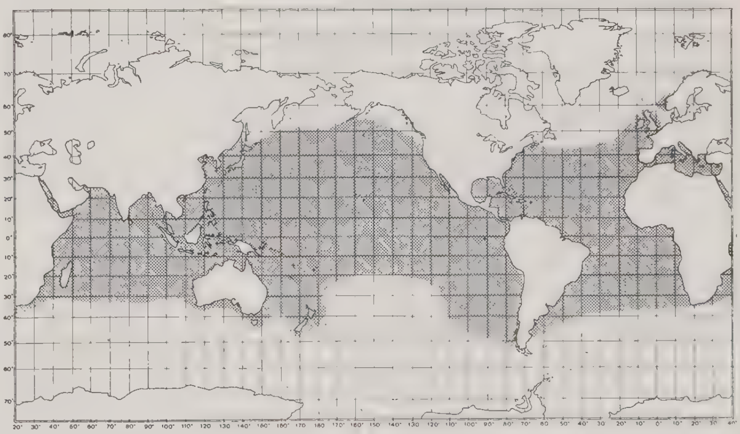


upper and lower teeth
from left side

Field Marks : Spindle-shaped body, long, acutely conical snout, large bladelike teeth without cusplets or serrations, pectoral fins rather narrow-tipped and with anterior margins less than head length, large first dorsal fin and minute, pivoting second dorsal and anal fins, strong keels on caudal peduncle, no secondary keels on caudal base, crescentic caudal fin, ventral surface of body white.

Diagnostic Features : Body moderately slender. Snout acutely conical; eye moderately large; cusps of first upper anterior teeth with incomplete cutting edges; tips of anterior teeth strongly reflexed, cusps narrower and more oblique. Pectoral fins moderately long and broad, shorter than head. Colour: underside of snout white.

Geographical Distribution : Coastal and oceanic, temperate and tropical. Western Atlantic: Gulf of Maine to southern Brazil and ? northern Argentina, including Gulf of Mexico and Caribbean. Eastern Atlantic: Norway, British Isles and Mediterranean to Ivory Coast, Ghana, and South Africa. Indo-West Pacific: South Africa and Red Sea to Pakistan, India, Indonesia, the Koreas, Japan, USSR (Primorsk Kray), Australia (Queensland, Tasmania, South and western Australia, Victoria, New South Wales), New Zealand, New Caledonia, Fiji. Central Pacific: From south of Aleutian Islands to Society Islands, including Hawaiian Islands. Eastern Pacific: Southern California and exceptionally Washington (USA) to central Chile.



Habitat and Biology : The shortfin make is a common, extremely active, offshore littoral and epipelagic species found in tropical and warm temperate seas but seldom occurring in waters below 16°C. This shark occurs from the surface down to at least 152 m. The peregrine falcon of the shark world, the shortfin mako may be the fastest shark and one of the swiftest and most active fishes. It is famed as a jumper, leaping several times its length from the water, and is capable of extreme bursts of speed when hooked and in pursuit of prey. For a shark of such a great fame, particularly in the angling literature, knowledge of its biology is surprisingly sketchy.

The shortfin mako, in the extreme northern and southern parts of its range, has a tendency to follow movements of warm water masses poleward in the summer. General movements of this shark are not well known.

This species is ovoviviparous and a uterine cannibal, with 4 to 16 young in a litter.

The shortfin mako is primarily an eater of other fishes, with a wide variety of prey including mackerels, tunas, bonitos, and other scombrids, anchovies, herrings, grunts, lancetfishes, cod, ling, whiting and other gadids, Australian salmon (Arripis), yellowtails and other carangids, sea basses, porgies, swordfish, and other sharks (blue sharks, Prionace, grey sharks, Carcharhinus, and hammerheads Sphyrna), but also sea turtle heads, a 'porpoise' (probably a pelagic dolphin), and also squids, salps, and occasionally detritus. Surprisingly, marine mammals (in the form of pelagic dolphins) are rarely reported in the diet of the shortfin mako, but they may be expected particularly in large individuals of the species. Very large shortfin makos over 3 m long have very broad, more flattened and triangular upper teeth, perhaps more suitable for dismembering large prey than the awl-shaped teeth of smaller makos.

Attacks on divers and swimmers by this shark are relatively rare and few are reliably reported, but these have occurred and suggest that this shark should be regarded as definitely dangerous. The offshore habitat of this species probably prevents it from coming in contact with many swimmers. Its speed, power, huge and wicked teeth, and aggressivenenss when a feeding stimulus (like speared fish) is present should be cause for divers, especially spearfishers, to treat this shark with extreme caution. The shortfin mako tends to respond vigorously when hooked or harassed, and it should NOT be speared or provoked underwater; a counterattack by this animate torpedo may be far too quick for anti-shark weapons to be effective. A number of attacks by the mako on boats are known, and these are second in number only to those perpetrated by the white shark. Most of these attacks probably have occurred while makos were being played by anglers. The angling and popular literature is rife with 'mako stories', in which these sharks bite, jump into, or even smash right through the boats of their assailants; anglers who suddenly find themselves sharing a boat with an aroused mako have been known to leap into the water!

Size : Maximum total length about 394 cm, possibly to 4 m, males maturing at about 195 cm and reaching at least 284 cm; females maturing at about 280 cm and reaching at least 394 cm; size at birth between 60 and 70 cm. Two recently published exponential length-weight curves are at slight variance:

$WT = 4.832 \times 10^{-6} TL^{3.10}$ (Stevens, 1983, N = 80, TL = 58-343 cm, Australia).

$WT = 1.193 \times 10^{-6} TL^{3.46}$ (Guitart Manday, 1975, N = 23, TL = 160-260 cm, Cuba).

A log curve, $\log WT = -4.608 + 2.925 \log TL$ (cm), was published by Strasburg (1958) for this species using central Pacific specimens.

Interest to Fisheries : This is an important species for longline fisheries where it occurs, because of its high-quality meat, and also is a prime game fish prized by sport anglers. Considerable fisheries for shortfin mako occur in the Mediterranean (landed in Italy), off West Africa, off Cuba, in the Gulf of Mexico and Caribbean, off southern California, and in the western and central Pacific. The meat is utilized fresh, frozen , smoked and dried salted for human consumption; the oil is extracted for vitamins; the fins used for shark-fin soup; the hides processed into leather and the jaws and teeth used for ornaments. This shark is caught in gillnets as well as on pelagic longlines and hook-and-line.

Literature : Whitley (1940); Bigelow & Schroeder (1948); Smith (1957c); Strasburg (1958); Farquhar (1963); Stead (1963); Garrick & Schultz (1963); Randall (1963, 1975); Applegate (1966); Guitart Manday (1966, 1975); Garrick (1967); Lineaweaver & Backus (1970); Mundus & Wisner (1971); Gubanov (1974, 1978); Bass, d'Aubrey & Kistnasamy (1975b); Ellis (1975); Gillmore (1983); Stevens (1983).

Remarks : The synonymy of this species follows Garrick (1967).

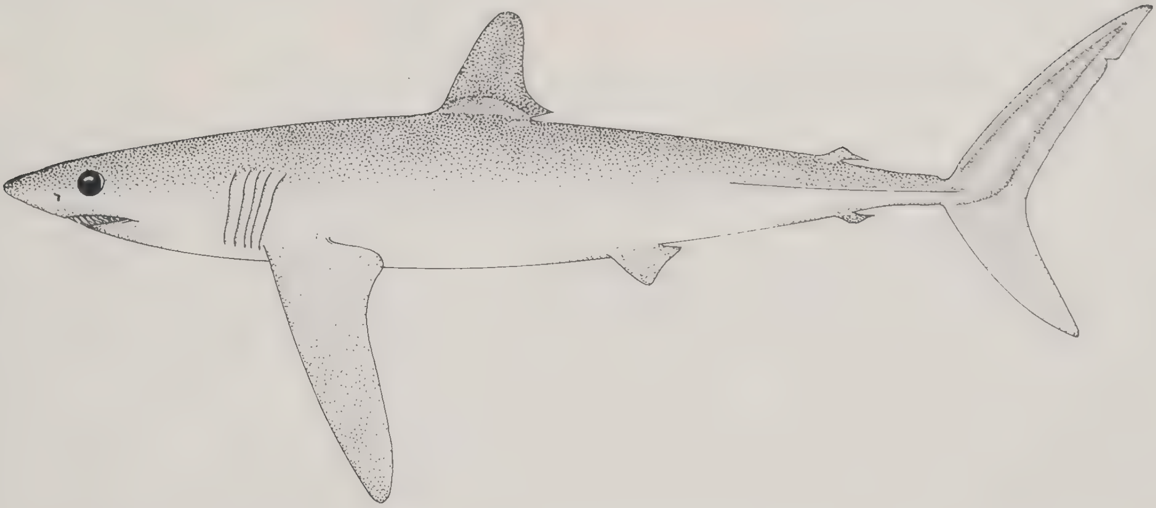
Isurus paucus Guitart Manday, 1966

LAMN Isur 2

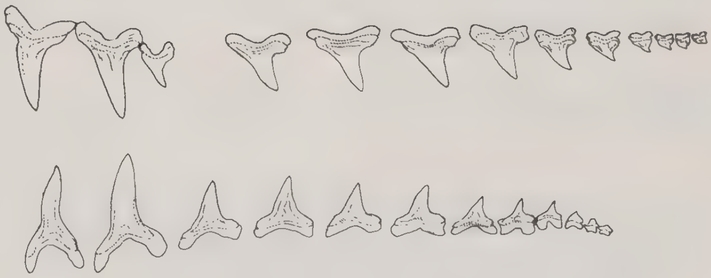
Isurus paucus Guitart Manday, 1966, Poeyana(Ser. A.), 1966(15):3, figs 1, 2A, 3A,C. Holotype: Apparently not named? Type Locality: Probably from Caribbean Sea near Cuba.

Synonymy : ? Lamliostoma belyaevi Glikman, 1964; Isurus alatus Garrick, 1967.

FAO Names : En - Longfin mako; Fr - Petit taupe; Sp - Marrajo carite.



Field Marks : Slender, spindle-shaped body, moderately long conical snout, large bladelike teeth without lateral cusplets or serrations, long gill slits, pectoral fins broad-tipped and as long or longer than head, large first dorsal fin with light free rear tip, minute, pivoting second dorsal and anal fins, strong keels on caudal peduncle, short secondary keels on caudal base, crescentic caudal fin, ventral surface of body dusky on underside of head.

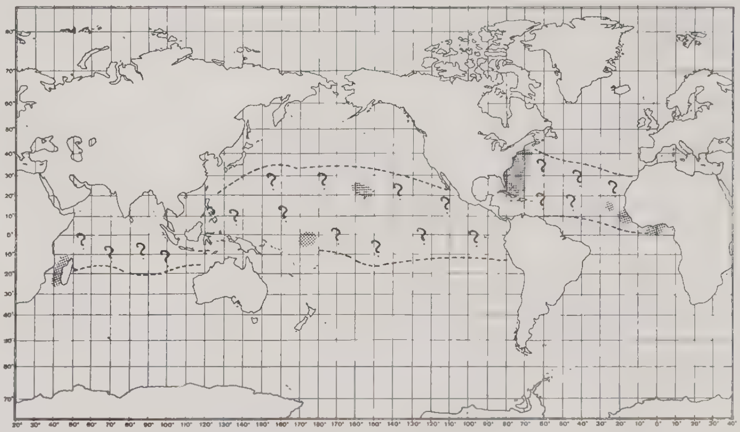


upper and lower teeth
from left side

Diagnostic Features : Body slender. Snout more bluntly conical, eyes relatively large; cusps of first upper anterior teeth with complete cutting edges; tips of anterior teeth not reflexed, cusps broader and less oblique. Pectoral fins very long and broad tipped, longer than head. Colour: underside of snout at least partly dusky.

Geographical Distribution : Oceanic and tropical. Western North Atlantic: Florida, Gulf Stream off eastern USA, Cuba. Eastern North Atlantic: Guinea, Ghana, ? Cape Verde Islands. Western Indian Ocean: Madagascar. Central Pacific: Near Phoenix Island and north of Hawaiian Islands.

Habitat and Biology : A little-known epipelagic, tropical and warm-temperate shark, apparently not uncommon in the western Atlantic and possibly in the central Pacific, but rather rare elsewhere. Its often slimmer build and broad, long pectoral fins suggests that it is slower and less active than its better-known relative, the shortfin mako (J. Casey, pers.comm.).



The longfin mako is ovoviviparous, with uterine cannibalism; fetuses are larger than those of I. oxyrinchus, are full-term at 92 to 97 cm, and occur as a litter of two young.

Food of this shark is presumably schooling fishes and pelagic cephalopods. This species has not been implicated in attacks on people or boats but is regarded as potentially dangerous because of its large size and big teeth.

Size : Maximum total length reported 417 cm, an adult male (central Pacific) was adult at 245 cm, adult females (western North Atlantic) were from 245 to 417 cm long; size at birth presumably about 97 cm.

Interest to Fisheries : Probably taken regularly in the tropical pelagic Japanese longline fisheries (marketed in Tokyo), but otherwise often taken in the Cuban longline fishery off the north coast of Cuba. It is utilized fresh, frozen and dried salted for human consumption. In addition to longlines, the species is taken with hook-and-line, and with anchored gillnets.

Literature : Guitart Manday (1966, 1975); Garrick (1967); Bass, d'Aubrey & Kistnasamy (1975b); Fourmanoir & Laborde (1978); Dodrill & Gillmore (1979); Gillmore (1983).

Remarks : Some writers (Garrick, 1967, Compagno, 1977, 1981a) thought that the species *Lamiostoma belyaevi* Glikman, 1964 might prove to be an earlier name for *I. paucus*, particularly because a stuffed *Isurus* illustrated in a photograph in Glikman (1964, figs 31-32) and labelled *L. belyaevi* appeared to be a longfin mako. Unfortunately this may be irrelevant even if correct. A translation of Glikman's description of *L. belyaevi* (pp 105. 132-133; by Mrs. L.J. Dempster with the aid of Dr V.V. Barsukov) revealed that Glikman deliberately refrained from naming the stuffed *Isurus* as holotype of *L. belyaevi* but instead picked one lot of teeth crowns dredged from the ocean bottom 5120 m deep at RV *Vitiaz* station 5128, 13°00'N, 176°04'E (Glikman, 1964, pl. 31, figs 13, 14, 18, 19) for this role. Examination of Glikman's photos did not convince me that the shark or sharks represented by these teeth were necessarily conspecific with *I. paucus* and were not conspecific with *I. oxyrinchus* or even some extinct *Isurus* species. Hence I cannot recommend the substitution of the species name *belyaevi* for *paucus*, especially because the former is based on such poor material. It is uncertain if the stuffed specimen illustrated by Glikman is *I. paucus* also, because some of the characters ascribed to it (snout very long and acute, pectoral fins falcate, and pectoral fin length slightly less than the distance from snout tip to upper margin of first gill opening, vs. snout short and bluntly conical, pectoral fins not strongly falcate, and pectoral fin length much longer than the distance from snout tip to upper margin of first gill opening in *I. paucus*) indicate that it might be a specimen of *I. oxyrinchus* instead.

Lamna Cuvier, 1817

LAMN Lamn

Genus : Subgenus *Lamna* Cuvier, 1817 (genus *Squalus* Linnaeus, 1758), *Reg.Anim.*, ed. 1, 2:126.

Type Species : *Squalus cornumicus* Bloch & Schneider, 1801, by monotypy, equals *S. cornubicus* Gmelin, 1789; a junior synonym of *S. nasus* Bonnaterre, 1788.

Synonymy : Genus *Lamia* Risso, 1826 (not *Lamia* Fabricius, 1775 in Insecta); Genus *Selanonius* Fleming, 1828; Genus *Exoles* Gistel, 1848.

Diagnostic Features : Body very stout. Snout acutely conical, rather long; nostrils more mesial on snout, situated medial to head rim in ventral view; mouth broadly parabolic; teeth narrow and thick, awl-shaped, with narrow smooth-edged, nearly straight cusps and usually well-developed lateral cusplets (except in young below 1 m long); intermediate teeth in upper jaw small, less than half height of upper anteriors. First dorsal origin over or just behind the pectoral insertions, anal origin about under second dorsal origin; small secondary keels present on base of caudal fin just below primary keels.

Remarks : Specimens and the literature suggest that there are only two species in the genus, with *L. philippi* from Chile and *L. whitleyi* from New Zealand and Australia most probably being synonyms of *L. nasus*. As shown by Bigelow & Schroeder (1948) and Nakaya (1971), *L. ditropis* is readily separable from *L. nasus*.

Key to Species :

1a. Snout relatively long, distance from snout tip to eye 2 or less times in distance from eye to first gill opening. Underside of body white, without dark spots and blotches, free rear tip of first dorsal abruptly white .... ***L. nasus***

1b. Snout shorter, distance from snout tip to eye 2.5 or more times in distance from eye to first gill opening. Underside of body white with dark spots and blotches (except possibly in very small individuals), free rear tip of first dorsal not abruptly white .... ***L. ditropis***

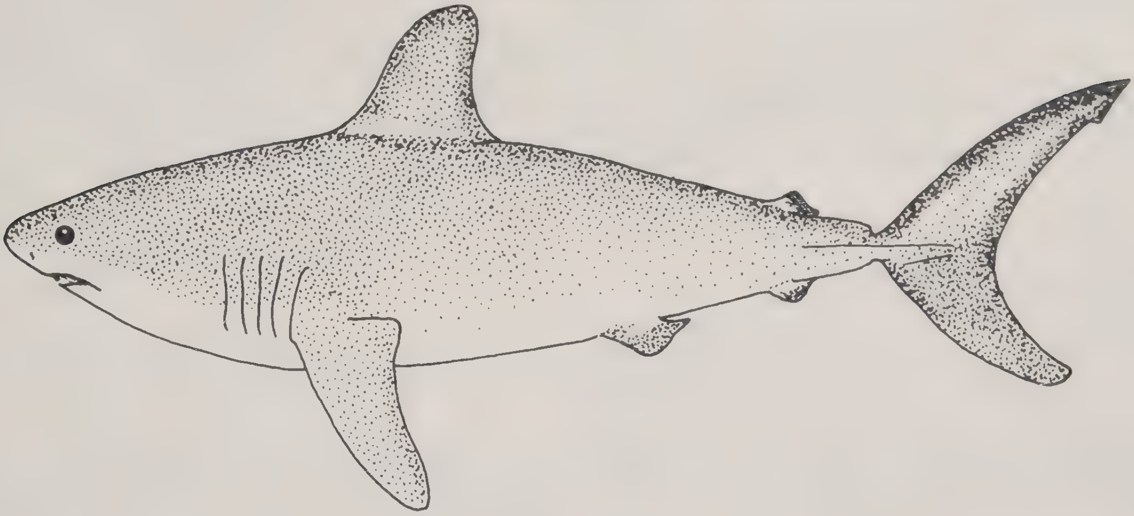
Lamna ditropis Hubbs & Follett, 1947

LAMN Lamn 2

Lamna ditropis Hubbs & Follett, 1947, *Copeia*, 1947(3):194. Holotype: Museum of Comparative Zoology, Harvard U., MCZ 36471, adult male. Type Locality: La Jolla, California, depth 92 to 107 m.

Synonymy : None.

FAO Names : En - Salmon shark; Fr - Requin-taupe saumon; Sp - Marrajo salmón.



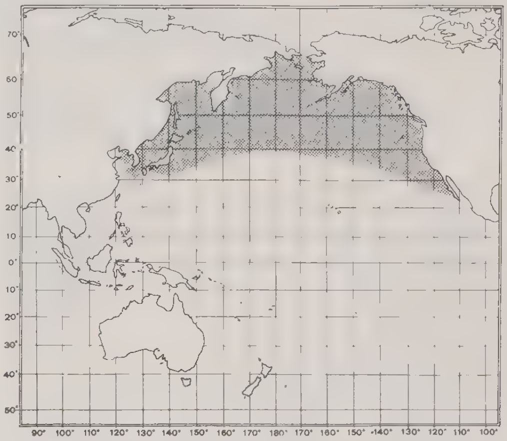
Field Marks : Heavy spindle-shaped body, short conical snout, moderately large bladelike teeth with lateral cusplets, long gill slits, large first dorsal fin with dark free rear tip, minute, pivoting second dorsal and anal fins, strong keels on caudal peduncle, short secondary keels on caudal base, crescentic caudal fin, dusky blotches on ventral surface of body.

Diagnostic Features : Snout short, length of snout about 2.7 times in distance from eyes to first gill opening; first upper lateral teeth with strongly oblique cusps. Colour: first dorsal fin uniformly dark, no light rear tip; ventral surface of body white with dusky blotches.

Geographical Distribution : Coastal and oceanic. North Pacific: Japan and the Koreas, Sea of Okhotsk to Bering Sea and southward to southern California and possibly Baja California, Mexico.

Habitat and Biology : A common coastal-littoral and epipelagic shark with a preference for boreal to cool temperate waters, found at depths from the surface to at least 152 m. Salmon sharks are common in continental offshore waters but range inshore to just off beaches; they also are abundant far from land in the North Pacific ocean basin, along with their salmon prey. Salmon sharks occur singly and in schools or feeding aggregates of several individuals. They are swift-swimming sharks, maintaining a body temperature well above ambient water temperature.

This shark is ovoviviparous, with uterine cannibalism; litter size is up to 4 young.



The salmon shark is a proverbially voracious feeder on Pacific salmon (Oncorhynchus), though lancetfishes, daggerteeth (Anotopterus), lumpfishes, sculpins, Atka mackeral (Pleurogrammus), pollock, and tomcod are also eaten.

The salmon shark has been regarded as potentially dangerous because of its large size and relationship to known dangerous species, but has never or seldom been implicated in an attack on people. There are a few unsubstantiated attacks reported for the species, but possibly by confusion with the great white shark. Recently divers have seen and photographed schools of adult salmon sharks underwater, with no aggressive or threatening overtures on the part of the sharks (B. Lea, pers.comm.).

Size : Maximum total length about 305 cm, males maturing between 180 and 240 cm.

Interest to Fisheries : Fished in the North Pacific by Japanese coastal longliners and by sports anglers in Alaska and Canada using rod and reel. They are commonly caught by Japanese, US and Canadian offshore salmon gillnetters but are currently discarded. They are occasionally trammel-netted by halibut fishermen off California and recently have begun to show up in numbers in gillnets set by thresher fishermen in northern-central California, but are presently not considered as marketable. The bulk of the fish currently caught are considered a nuisance for the damage they do to salmon nets.

The flesh of the salmon shark is used fresh for human consumption in Japan, where it is processed into various fish products, and to a lesser extent in Alaska and California. Its oil, skin (for leather), and fins (for shark-fin soup) are utilized also.

Literature : Bigelow & Schroeder (1948); Roedel & Ripley (1950); Farquhar (1963); Nakaya (1971); Hart (1973); Uquuhart (1981); S. Kato & B. Lea, (pers.comm.).

Remarks : See Nakaya (1971) for a detailed comparison of this species with Lamna nasus. Pillai & Honma (1978) reported L. ditropis from the southern Indian Ocean, without data confirming the identification. Presumably the species in question was Lamna nasus, which is known from the southern Indian Ocean (open sea from 800 to 965 km, northeastern of Kerguelen Island and from 640 to 800 km SSE of St. Paul Island, unpublished record by L.J.V. Compagno; also near Kerguelen Island, Duhamel & Ozouf-Costaz, 1982).

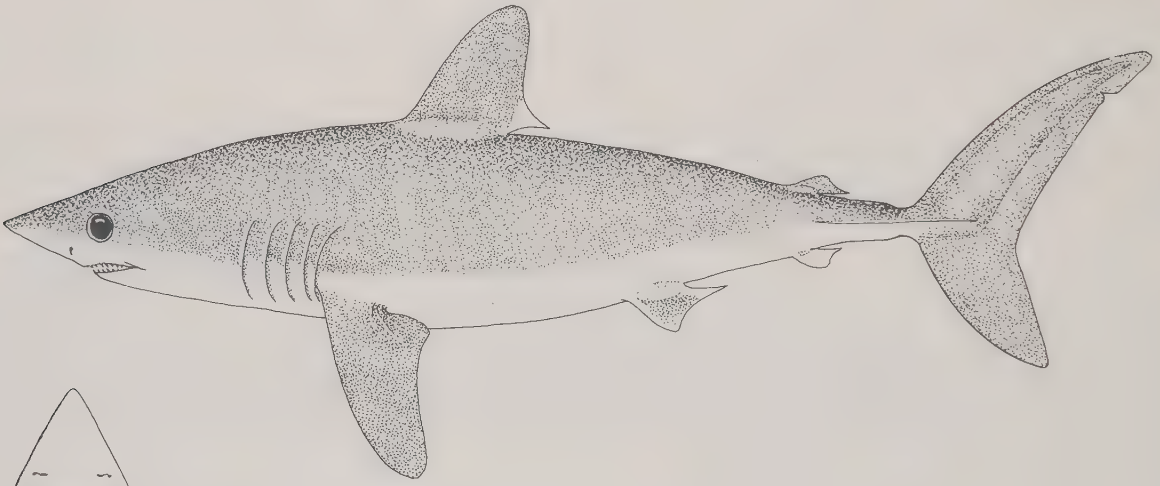
Lamna nasus (Bonnaterre, 1788)

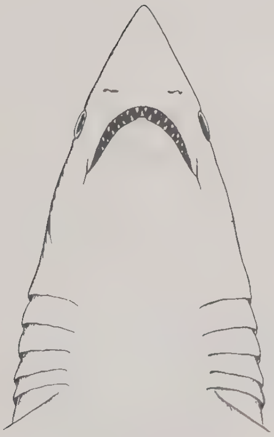
LAMN Lamn 1

Squalus nasus Bonnaterre, 1788, Tabl.encyclop.méthod.trois reg.nat., Ichthyol., Paris, 10. Holotype: Unknown. Type Locality: Probably British waters.

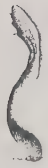
Synonymy : Squalus glaucus Gunnerus, 1758 (not S. glaucus Linnaeus, 1758 = Prionace glauca); Squalus cornubicus Gmelin, 1789; Squalus pennanti Walbaum, 1792 (also Lamna pennanti Desvaux, 1851); Squalus monensis Shaw, 1804; Squalus cornubiensis Pennant, 1812; Squalus selanonus Walker, in Leach, 1818; Selanonius walkeri Fleming, 1828; Lamna punctata Storer, 1839; Oxyrhina daekayi Gill, 1862; Lamna philippi Perez Canto, 1886; Lamna whitleyi Phillipps, 1935.

FAO Names : En - Porbeagle; Fr - Requin-taupe commun; Sp - Marrajo sardinero.

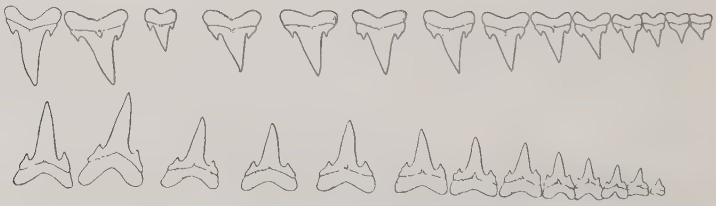




underside of head



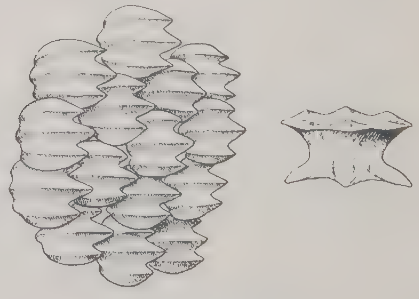
rigth nostril



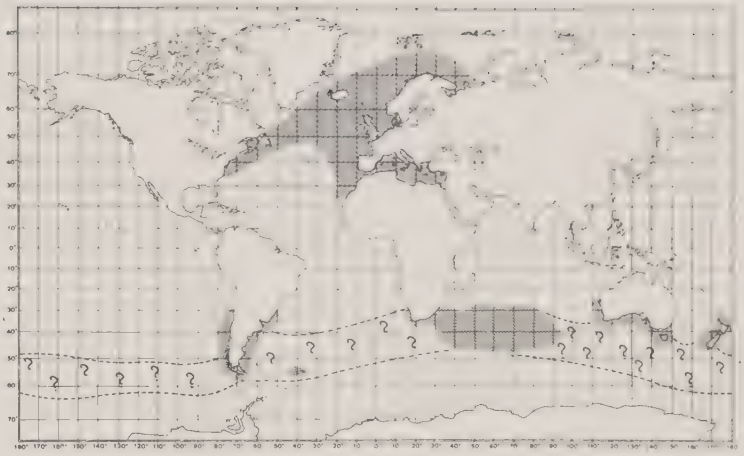
upper and lower teeth from left side

Field Marks : Heavy spindle-shaped body, moderately long conical snout, moderately large bladelike teeth with lateral cusplets, long gill slits, large first dorsal fin with light free rear tip, minute, pivoting second dorsal and anal fins, strong keels on caudal peduncle, short secondary keels on caudal base, crescentic caudal fin, ventral surface of body white.

Diagnostic Features : Snout moderately long, length about 2 times in distance from eyes to first gill opening; first upper lateral teeth with cusps erect or nearly so. Colour: first dorsal fin with a conspicuous white rear tip; ventral surface of body white without dusky blotches.



dermal denticles



Geographical Distribution : Coastal and oceanic, amphitemperate. Western Atlantic: Newfoundland and Gulf of St. Lawrence to New Jersey and ? South Carolina (USA); ? southern Brazil to southern Argentina. Eastern Atlantic: Iceland and western Barents Sea to Gibraltar, Mediterranean, Morocco, Madeira, western Cape Province, South Africa. South central Indian Ocean. Western South Pacific: Australia (Western and South Australia, Tasmania), New Zealand. Eastern South Pacific: Chile. Subantarctic waters off South Georgia and Kerguelen Islands.

Habitat and Biology : A common littoral and epipelagic shark, most abundant on the continental offshore fishing banks but also found far from land in ocean basins and occasionally close inshore. This shark prefers cold water, less than 18°C, and does not occur in equatorial seas. The porbeagle is described as active and strong-swimming in pursuit of prey, but when hooked is relatively sluggish and inactive in comparison to the shortfin mako (Isurus oxyrinchus), and does not engage in spectacular leaps like that species.

The porbeagle is found at the surface down to the bottom, singly and in schools and feeding aggregations, and has been caught at depths down to at least 366 m. Porbeagles may come inshore and to the surface in summer, but will stay in winter offshore and beneath the surface. Fisheries catches in Europe indicate that the porbeagle has populational segregation by size (age) and sex.

Porbeagles breed on both sides of the North Atlantic, off the Atlantic coast of Europe and the British Isles, where females have embryos during most of the year except July through September, and off North America from Massachusetts to Maine, where females can be found with young at all times of year. Young are apparently born in the spring off Europe and late summer off North America. Mating in European waters occurs in late summer, and breeding there probably occurs every year. Breeding populations presumably exist elsewhere in the range of this species, but details are lacking.

The porbeagle is ovoviviparous and a uterine cannibal, with litters of 1 to 5 young. The fetuses grow enormously by feeding on fertilized eggs, and develop grotesquely expanded abdomens and branchial regions. In European waters the gestation period has been estimated at about 8 months.

The porbeagle may take 5 or more years to reach maturity, and can live to an age of 20 to 30 or more years. Vertebral rings on this species have been demonstrated to be annual, from correlation with length-frequency data. Prior to the intensive fishery that greatly reduced the numbers of this shark in European waters, the annual mortality for the species was an estimated 18% under low human exploitation and probably minimal predation pressure from other species.

This shark is a voracious feeder on small pelagic schooling fishes, including mackerels, pilchards and herring, various gadoids including cod, hakes, haddock, cusk, and whiting, and John dories, dogfishies and tope sharks (Squalus and Galeorhinus), and squids. It is regarded as potentially dangerous to people because of its size and activity, but has never or very seldom has been indicted in an attack on people or boats (unlike its close relatives the shortfin mako and great white sharks). An unconfirmed attack by this species as 'mackerel shark' has been reported, but it could have resulted from confusion with the great white shark.

Size : Maximum total length 300+ cm, possibly to 370 cm but most smaller, adult males at 219 to 262 cm, adult females 152 to at least 219 cm and possibly to 370 cm; size at birth between 60 and 75 cm.

Interest to Fisheries : This species has been heavily fished and utilized in the North Atlantic and the Mediterranean by a number of countries, including Norway, Denmark, the Faroer Islands, the United Kingdom, France, previously Spain, with an estimated total of 1530 metric tons landed in 1981 (FAO Yearbook of Fishery Statistics, 1983). A considerable fishery by Japanese longliners exists in the southern central Indian Ocean. It is used fresh and dried salted for human consumption; for oil and fishmeal; and for fins for shark-fin soup. The species is primarily caught with pelagic longlines; also pelagic and bottom trawls, handlines and gillnets. Stocks in the North Atlantic show signs of serious over-fishing in the form of greatly declining catches (3226 metric tons in 1978, FAO Yearbook of Fishery Statistics, 1983).

Literature : Whitley (1940); Bigelow & Schroeder (1948); Aasen (1963); Farquhar (1963); Garrick & Schultz (1963); Templeman (1963); Baldridge (1974); Duhamel & Ozouf-Costaz (1982); Stevens (1983).

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